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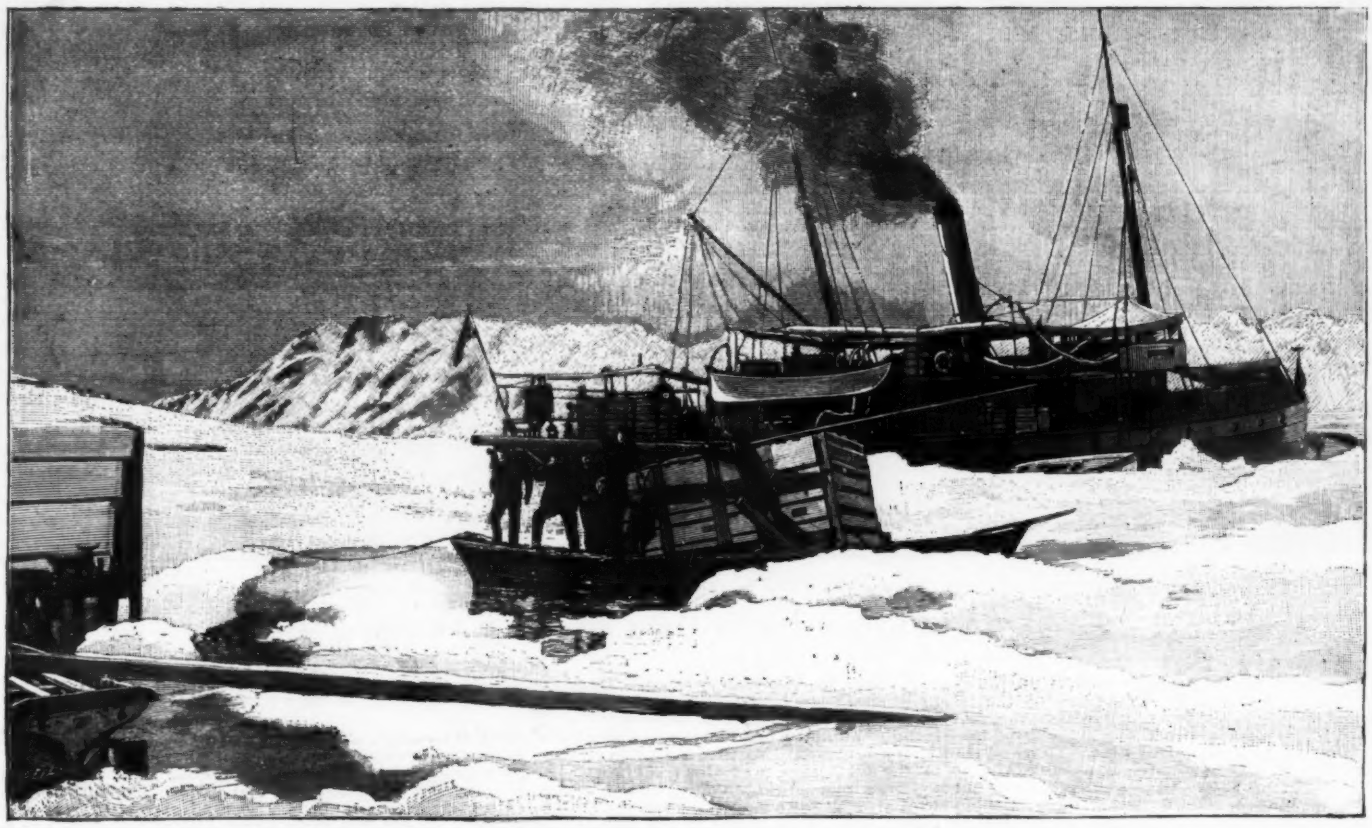


TRANSPORTATION OF THE PACKING CASE CONTAINING THE BALLOON, JUNE 14, 1897.

INSPECTION OF THE BALLOON, JULY 2, 1897.

ANDRÉE'S POLAR EXPEDITION.

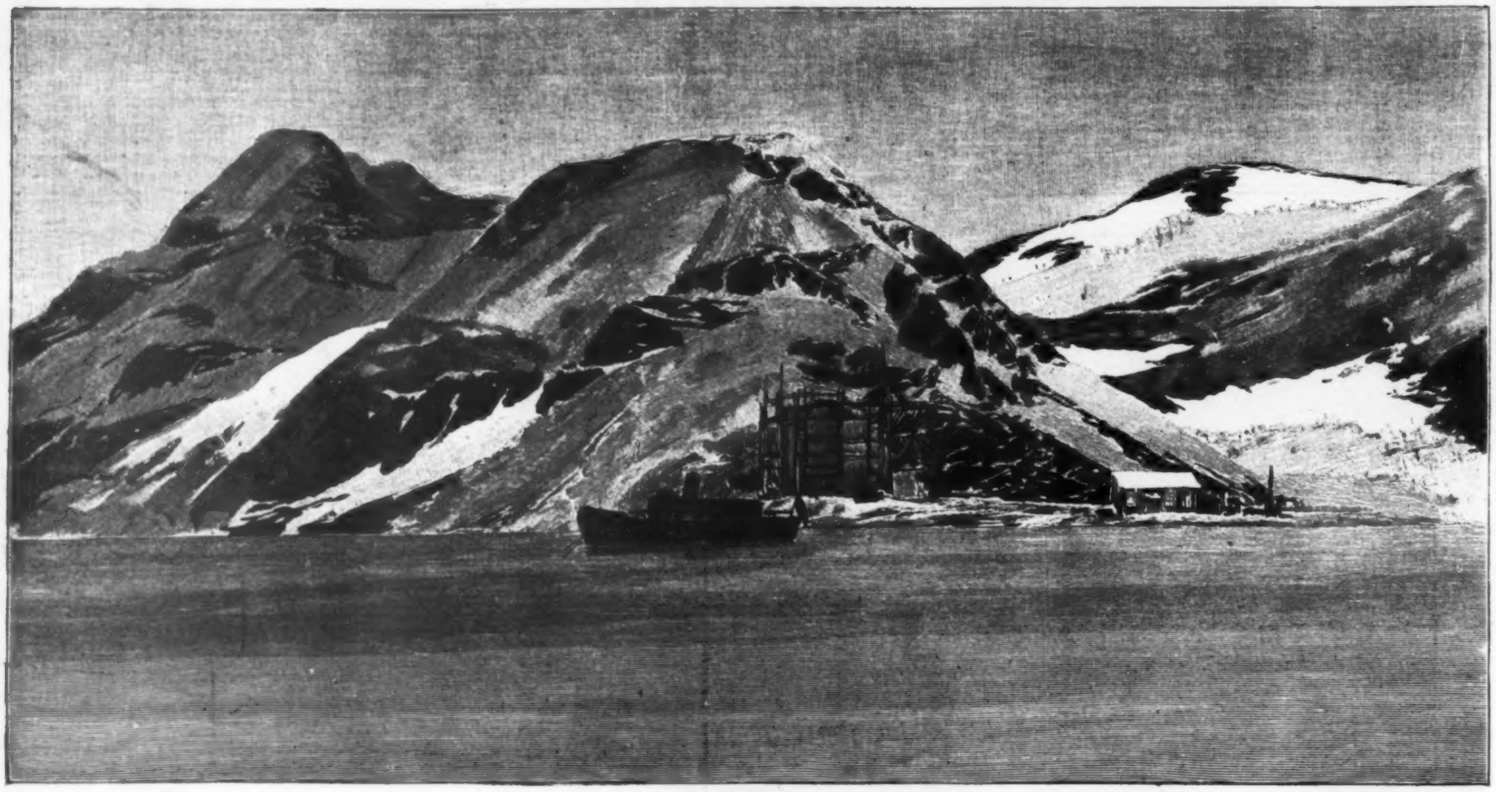
ANDRÉE'S POLAR EXPEDITION.

The recent departure of Andrée has once more centered our attention on those northern islands which have so often been the starting place of polar expeditions. Quite fresh in our memories is the sailing of the Fram, and Nansen's home-coming, yet we follow with renewed interest the moves of the daring balloonist, who in his turn defies the prowess which guards the Arctic regions and the pole. It will be remembered that Andrée purposed to enter upon his perilous enterprise last year, but that contrary winds prevented him from carrying out his plan at that time. To avoid the repetition of this turn of events, if possible, and to make sure of his opportunities, Andrée set out for Danes Island fully a month before time. He left Stockholm on the 18th of May and reached Tromsö in a week on board the fine Swedish man-of-war the Svensksund. From Tromsö another nine days or so took him to Danes Island. There he found the balloon house erected the year before still well preserved. Probably a dense snow cover had protected it against the rigor of the Arctic winter. Some alteration had, however, to be made, an addition to the balloon making increased storage room necessary. The diameter of this octagonal building, of which we give an illustration, is 78 feet; the side toward the south, that is, toward the hill, is 65 feet high; the front measures only 57 feet in height. The front was to be torn down as soon as the right wind—the southeasterly wind—set in. The site of this storage house was well chosen. One inducement to its adoption lay in the previous location there of Pike's little wooden hut. Pike, an English sportsman of means, made this place his station, from which he started his hunting expeditions. The house was unoccupied of late, on account of an illness of its owner, and had been placed at Andrée's disposal. We give a cut representing this hut, on the left hand side of which can be seen the gas generating plant. Andrée availed himself of the log house mostly as a store house for his provisions and as a pigeon loft. With regard to the attempts at sending messages with these birds, we fear that they were scarcely promising. The pigeons sent last year did not reach their destination, and probably they were attacked and overpowered by the large Arctic birds on Bears Island, which lies on the way to the continent, and where the winged message bearers rest on the way.

On the 14th of June, the balloon was transported from the Svensksund to its storage house by sledge, as in our illustration. It was filled, and carefully examined for leaks. This is done by applying to the surface of the envelope paper saturated with acetate of lead solution. The sulphureted hydrogen in the gas turns these strips of paper black if it comes in contact with them, and this being a very delicate test, any slight leak is easily detected. The operation involves the scaling of the balloon, and requires considerable agility on the part of the workers. Our illustration will graphically present this fact to our readers.

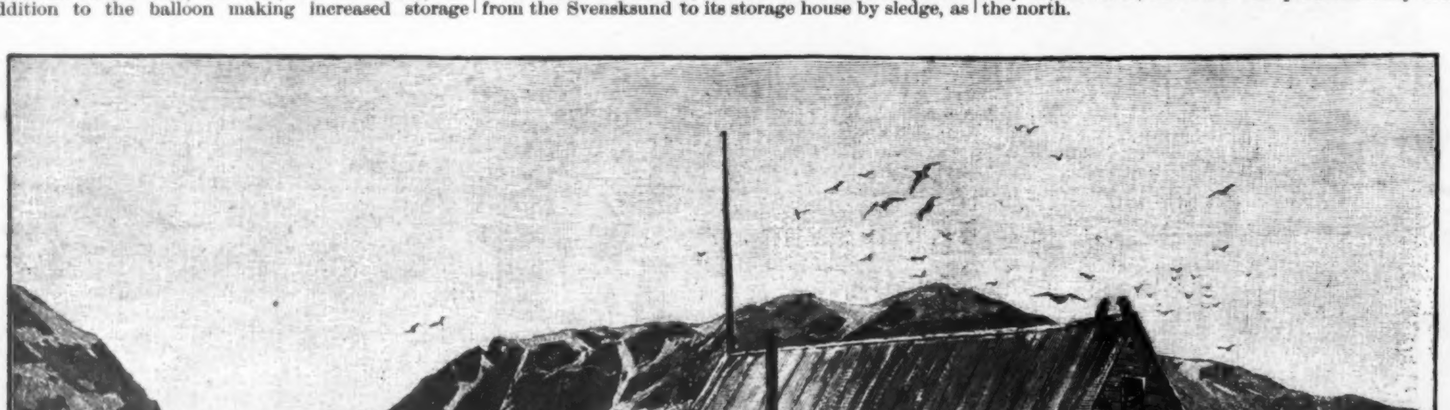
On the 27th of June, the balloon was announced ready to start. The filling had taken eighty-nine hours, being begun on June 19, and completed on June 22. The provisions, packed in bags, lay ready for shipment, the car was ready, too, and the balloon, with the addition mentioned above, rose to a height of 70 feet. Stretched over it was placed a covering of sail cloth, as a protection against rain or snow, while tight felt strips provided a resistance against the internal pressure.

Of the front of the storehouse two stories were already pulled down. The corner posts could readily be hewn down, so that the balloon could freely emerge to the north. Andrée intended to make his ascent on July 1; however, the wind was predominantly from the north.



The Gunboat Svensksund.

THE BALLOON HOUSE IN VIRGO BAY, DANES ISLAND.



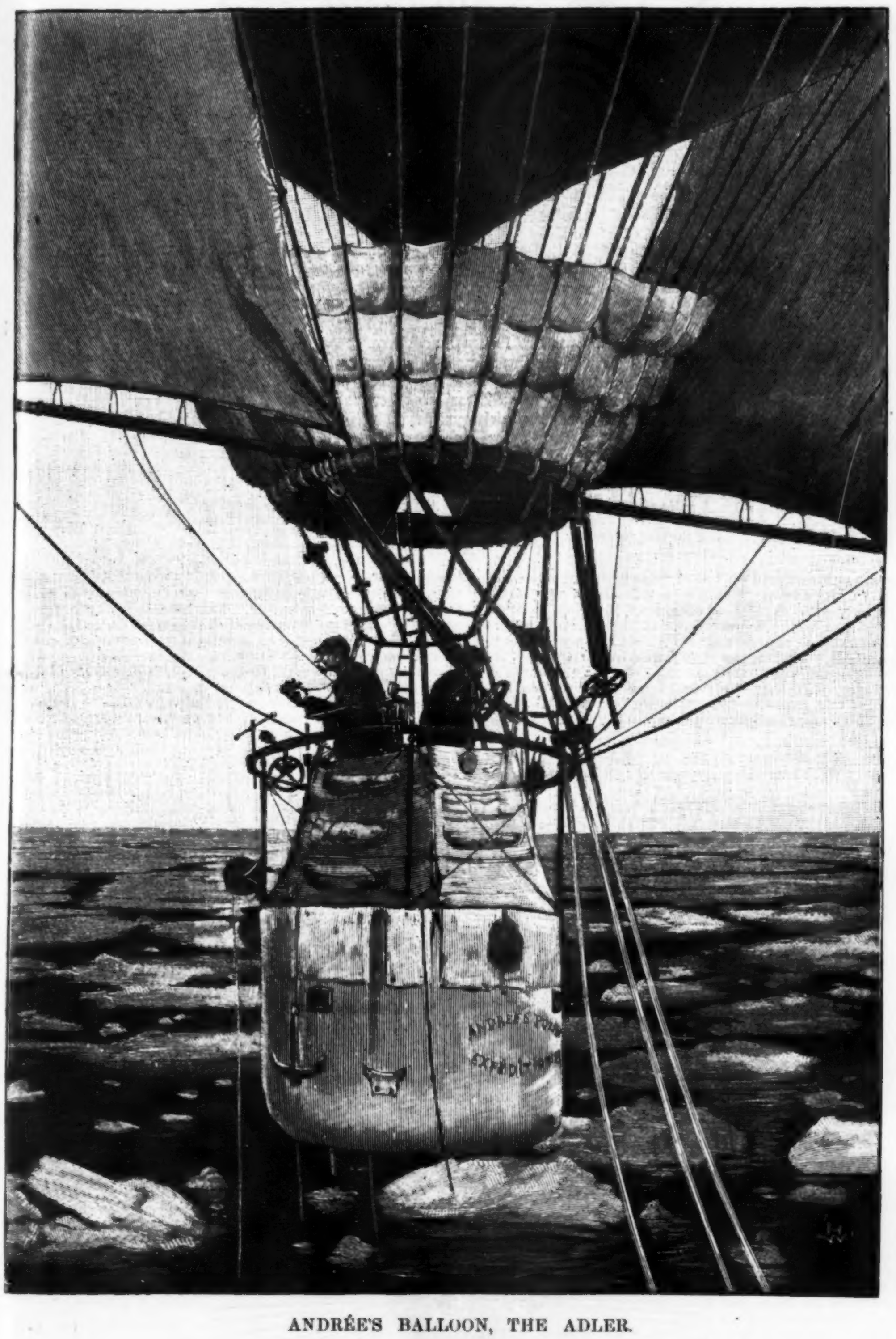
Gas pipe to balloon.

PIKE'S LOG HOUSE ON DANES ISLAND AND GAS WORKS.

On the 11th of the same month, all being ready and the breeze blowing from the south, Andrée, with his companions' assent, gave orders for departure. Before ascending, the head of the expedition sent telegrams to the King of Sweden and to his Swedish fellow citizens, the former to express his gratitude for the support given, the latter to give notice of his starting and to tender his farewell.

Then the ascent began. It took place under altogether favorable circumstances, amid a thunder of cheers and godspeeds. The balloon rose some 650 feet, then sank again to sea level, and finally ascended for good after the aeronaut had thrown some ballast. With a velocity of about 22 miles per hour it was carried north, remaining in sight for one hour.

The 13th of July the Svensksund left Danes Island on its return journey, and during the whole time of crossing faced a southwesterly wind; perhaps in the further north the aeronauts were fortunate enough to find what they hoped for—a more favorable wind.



ANDRÉE'S BALLOON, THE ADLER.

Andrée started with the same absolute confidence in his craft which has so fortunately led Nansen on his expedition—let us hope that, like his sea-faring predecessor, Andrée will be safely brought home, and that his return may mark a new period of advance, of additional knowledge gained in a field which for centuries has called the braves of many nations to risk their lives for the sake of science and in search for truth.

Our illustrations are taken partly from L'Illustration and partly from Illustrirte Zeitung.

The stock company for automatic sale in Germany has received permission to place in the post offices of Berlin automatic machines selling post cards and stamps. For their trouble in putting up these automatons the company are permitted to sell by a similar machine on their own account post cards with local views.—Uhland's Wochenschrift.

THE FLORIDA SPONGE INDUSTRY.

By WILLIAM B. BURK, in the American Journal of Pharmacy.

SPONGE is a substance with which almost every one is familiar, as there are but few living in civilized communities who do not find occasion to use it for a great variety of purposes. The article is so very useful that a large number of inconveniences would arise if it could not be obtained. Without it, what would the surgeon, the traveler or the housekeeper do? And yet most of those who use sponges in an infinite variety of ways all their lives never stop to consider how they are formed; that is, whether they are plants or animals, or what their history or habits may have been.

Sponges consist of a framework, or skeleton, coated with gelatinous matter and forming a non-irritable mass, which is connected internally with canals of various sizes. The ova are very numerous, and present in appearance the form of irregular shaped granules derived from the gelatinous matter which grow into ciliated germs, and, falling at maturity into small canals, are then expelled through the orifices. When alive the body is covered by a gelatinous film, which, being provided with cilia, causes a current of water to pass in at the smaller pores and out at the larger apertures, the sponge probably assimilating the nutritive principles contained in the water.

Sponges are found abundantly in tropical waters generally. They gradually decrease in numbers toward the colder latitudes till they become entirely extinct. They vary in shape. Some are shaped like a vase, others are semi-cylindrical, others flat like an open fan, and some are round.

The commerce in sponges is of considerable importance. The great difficulty which is experienced in any attempt to distinguish species results from the extreme susceptibility of all keratose sponges to any change in external conditions. They appear to require, for the production of the forms in abundance, tropical or subtropical seas, and attain by far their greatest development in the number of the forms and species in the Gulf of Mexico and West Indian Seas. The typical forms, the commercial sponges, are essentially confined to the waters of the Bahaman Archipelago and the southern and western coasts of Florida in the western hemisphere and to the Mediterranean and Red Seas in the other.

The Florida sponge grounds form three separate and elongated stretches along the southern and western coasts of the State. The first includes nearly all of the Florida reefs, the second extends from Anclote Keys to Cedar Keys, and the third from just north of Cedar Keys to Saint Mark's. The Florida grounds have a linear extent of about 120 miles, beginning at Key Biscayne, in the northeast, and ending in the south at northwest channel, just west of Key West. The northwestern half of the grounds is very narrow, having an average width of only about five miles, and being limited to the outer side of the reef. At about the Matacumbo Reefs the grounds broaden out so as to cover the entire width of the reefs, which are much broader here than at the north. The entire southern half of the grounds has more or less of the same breadth, which is about 13 or 14 miles.

The second sponging ground begins just south of Anclote Keys, with a breadth of 7 or 8 miles, which it maintains from a point opposite Bat Fort to Sea Horse Reef, just south of Cedar Keys. The total length of this sponging ground is about 60 geographical miles. Its distance from the shore varies somewhat. At the south the inner edge approaches within 4 or 5 miles of the mainland, and comes close upon Anclote Keys; but throughout the remainder of its extent it is distant 6 to 8 miles from the shore until it touches the shallow bottom and reefs of Cedar Keys. The depth of water on these grounds, as indicated on the coast survey charts, ranges from 3 to 6 fathoms, but many portions are undoubtedly shallower than this. The northern ground, which maintains a nearly uniform width throughout, is about 70 miles long by about 15 miles broad. It approaches to within about 5 miles of the shore and terminates just off the mouth of Saint Mark's River; the depth of the water is the same as upon the next one to the south, i. e., from 3 to 6 fathoms. The total area of the Florida sponging grounds, which are now being worked, including also those that were formerly fished upon, but have since been more or less abandoned, may be roughly stated at about 3,000 square geographical miles. This probably does not include all of the sponging grounds occurring in Florida waters, for the fact that new areas are being constantly discovered would indicate that there might still be more to find, and it is certain that no strenuous efforts have yet been made to extend the grounds already known, the discovery of new ones having generally been made by accident.

The sponge fishery of the Florida coast differs from that of the Mediterranean in that sponges are not obtained by divers, but by means of a long hook fastened to the end of a long pole and managed from a small boat.

In Florida small vessels of from 5 to 50 tons measurement are employed to visit the grounds, to afford quarters for the men and to bring home the catch. These vessels are generally of light draught and schooner rigged, having proportionately large decks on which to carry boats, working gear and the sponges caught. The holds are of considerable size, for storing the sponges, and the cabins generally small, indicating a sacrifice of comfort to working room. Each vessel carries, according to its size, from five to fifteen men, one as cook and the remainder as fishermen, and also a small yawl boat to every two fishermen, to be used by them in securing the sponges. In addition to the working tools for taking sponges, they are provided with a sufficient quantity of provisions, wood and water for the trip, lasting from four to ten weeks.

The working outfit for a Florida sponging vessel consists of a few small yawl boats, called dingies, and a supply of sponge hooks and sponge glasses. The boats used are always made as light as possible. They are from 15 to 20 feet long and from 4 to 6 feet wide. The idea is to have the boats light enough to enable two men to haul them in and out over the side of the vessel, and yet strong enough to withstand the rough handling which they are sometimes subjected to, and to carry the heavy loads resulting from a day's catch. While catching sponges it is necessary to scull the small yawl boats (dingies) from the stern, and, for convenience in doing so, this form of sculling notch is used: A piece of oak plank about 6 inches wide and 1 foot long is notched at one end to fit the oar and inserted at the other between two guiding strips well fastened to the stern sheet. This sculling notch is placed at one side of the center of the stern sheet and is made to be easily removable in order that it may be taken out of the way when not needed. The sponge hooks are made of iron with three curved prongs, measuring about 5 to 6 inches in width. The entire length of a hook is about 8 inches, the upper end being made into a very strong socket for the insertion of the pole.

The sponge glass is made from an ordinary wooden bucket, the wooden bottom being replaced by one of ordinary window glass securely fastened by cement. In using a sponge glass it is placed upright on the surface of the water, and the handle of the bucket is placed on the back of the neck of the fisherman with his head thrust down in the bucket. In this way the fisherman can distinctly see very small objects in very deep water, and he can easily distinguish good sponges from those of an inferior grade.

When the sponger discovers a suitable sponge through the aid of the sponge glass, he hurriedly grasps his hook, and, plunging it directly upon the sponge, he skillfully pulls it from its habitation and brings it up to the surface and places it in the boat. As soon as the fisherman collects a sufficient quantity, he takes them to the vessel, where they are spread carefully on the deck in their natural upright position, so as to allow the slimy matter, called "gurry" by the sponger, to run off. During the first stages of decomposition they have a very unpleasant odor, something like decayed fishy matter. After the dingies collect sufficient sponges to make a vessel load, they are taken to what are called sponge crawls, which is an inclosure of about 10 to 12 feet, made generally by placing stakes in the beach where the water is from 2 to 3 feet deep.

Sponges, after being kept on the decks of the vessel

from one to two days, will generally be sufficiently cured to be taken to the crawls, where they are kept for a few days and then thoroughly washed and pounded with a flat stick. They are then placed upon strings of about 6 feet in length and taken to the markets, where they are sold at auction. They are generally sold in lots, and then carefully trimmed and packed in bales weighing from 15 to 100 pounds each, according to quality, the cheaper grades being generally packed in the larger bales.

The principal varieties of sponges found in Florida are the following: Sheep wool, yellow and grass. The Florida sheep wool are the best quality, being of very fine texture, soft and very strong and durable. The yellow sponge is of fine quality, but not strong in texture, and not near so soft or durable as the sheep wool sponges. The grass is very much inferior to the others, not being as strong nor so desirable in shape, and being easily torn.

There are no sponges found in the world to equal the Florida sheep wool for softness and strength, and no better bath sponge can be found than a good solid Florida sheep wool, although they are generally sold for washing carriages, etc. In former years Florida sponges were loaded with lime or sand in order to decrease the price, but of late very few loaded sponges have been placed upon the market.

Sponges in great variety are also found in many places in the West India Islands and in Cuba. The Cuban sponges are the next best to the Florida. The principal varieties found in Cuba or the West Indies are sheep wool, reef, yellow and grass, also velvet, which are next best to the sheep wool.

The finer grades of sponges are found principally in the Mediterranean, such as the fine surgeon's, toilet bathing and nursery sponges, and they are very much higher in price than any others.

Florida produces nearly double the amount of sponges that are imported from all other countries, that is, in value, not quantity, and the demand for good Florida sponges is considerably greater than the supply. Consequently, the prices must advance from year to year. The prices have more than doubled within the last twenty years for Florida sponges.

The fine, soft species of sponges, such as surgeon's, toilet, nursery, bath, etc., are found in great variety in the Mediterranean, and are fished principally by divers, sometimes at great depth. After being brought to the land they are buried in the sand and allowed to decompose, after which they are well washed and beaten with a small stick, and then packed in bags and sent direct to London, and again thoroughly cleaned and packed in cases according to size and quality. The large London dealers have almost complete control of the sponges found in the Mediterranean. There are a great many varieties found there, principally the fine surgeon's, toilet, bathing, potter's, fine thin flat (called elephant's ears by the native fishermen), fine cups, Zimocca toilet, Zimocca potter's, etc. Some of the finest cup sponges are sold at as high as $100 per dozen. The Mandruka bath sponges are also very expensive and very rare. Some of the cheaper species are also found in the same waters, but none like those found in Florida or Cuban waters.

ON THE DISTRIBUTION OF THE PELAGIC FORAMINIFERA AT THE SURFACE AND ON THE FLOOR OF THE OCEAN.

THE pelagic Foraminifera play a most important role in the economy of the present ocean, as well as in the geological history of our planet. Living specimens of these pelagic Protozoa are distributed everywhere in the surface waters of the open ocean, about fifteen or twenty species being met with in the surface waters of the tropics, and one or two dwarfed species are captured among the floating icebergs of the Arctic and Antarctic regions. The dead shells of these Foraminifera make up by far the larger part of the carbonate of lime present in the deep sea deposits known as Pteropod and Globigerina oozes, which cover about 50,000,000 square miles of the ocean's bed. In addition, they make up the major part of the carbonate of lime present in the other deep sea deposits, such as diatom ooze, radiolarian ooze, red clay, and the deeper terrigenous deposits which are laid down in close proximity to continents and oceanic islands. Indeed, it may be said that, taken as a whole, nine-tenths of the carbonate of lime in marine deposits from depths greater than one hundred fathoms is derived from the dead shells of the pelagic Foraminifera.

When the Challenger set out on her cruise around the world, all the naturalists of the expedition believed that the habitat of the Globigerinae was on the seabed in deep water. This opinion was held by Wallich,* Carpenter, and Wyville Thomson. Gwyn Jeffreys, however, took another view; he regarded the Globigerinae as surface organisms, and the Globigerina ooze as made up of dead shells which had fallen to the bottom from the surface waters. The fact that McDonald† and Major Owen had captured several species of these Foraminifera in tow nets at the sea surface appears to have been overlooked or forgotten. Huxley discussed this question, and while not coming to any definite conclusion on the subject, he held that the balance of evidence was in favor of those who maintained that the Globigerinae lived on the bottom of the ocean.

During the first few months of the Challenger expedition the attention of the naturalists was almost wholly taken up with the examination of the deep sea organisms obtained in the trawl and dredge, and with the larger animals procured at the surface. When, however, the expedition entered the tropics, I frequently observed Globigerinae, Orbulinae, Pulvinulinae, and Sphæroidinae at the bottom of the glass globes into which the contents of the surface nets were washed, and the attention of Wyville Thomson and the other naturalists was called to the fact. It was Wyville Thomson's opinion, however, that these shells really came from the deep sea deposits. It was the custom to sift and wash large quantities of the ooze procured in the dredge on the deck of the ship, and it was believed that some of the shells from the deck being washed overboard were subsequently caught by the tow nets dragging astern. But the appearance of the shells taken in the tow nets was so different from that of those procured from the bottom that I could not accept the above explanation. When the weather permitted, the tow nets were dragged, at considerable distances from the ship, from a rowing boat, and Foraminifera were procured in abundance. By using a water glass I was sometimes able to dip up a single specimen in a glass beaker without in any way touching it. When this quite agreed with the experience of the Challenger naturalists. Whenever the ship entered a bay, an estuary, or indeed any coastal waters, the pelagic Foraminifera became very rare or entirely disappeared from the nets, although they may have been abundant fifty miles from the coast. I have never seen a single specimen in the tow nets around the coasts of Scotland. In the Triton and Knight Errant expeditions pelagic Foraminifera were found in abundance in the Gulf

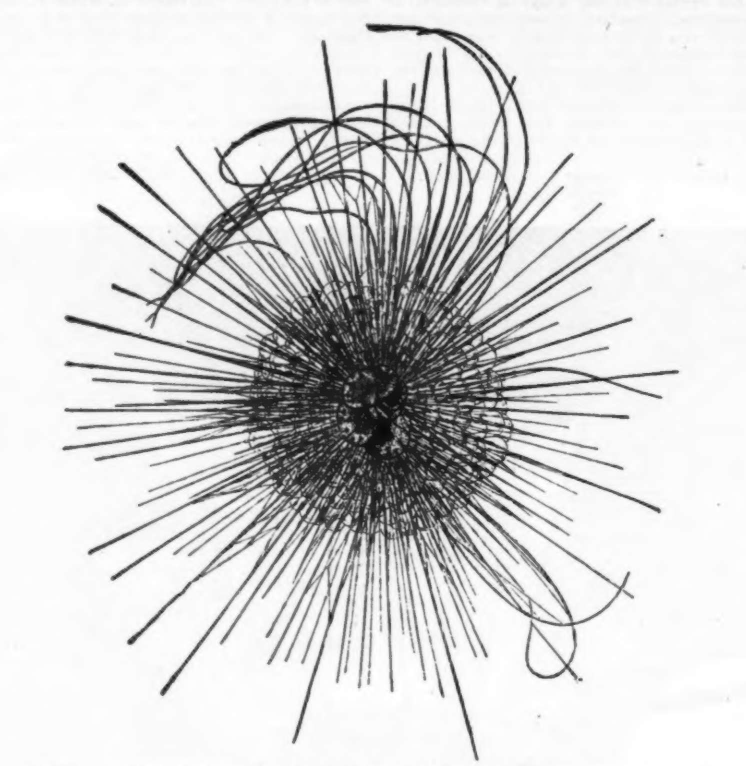


FIG. 1.—Hastigerina pelagica (d'Orbigny) [murrayi, Wyville Thomson] with floating apparatus and pseudopodia extended, as found floating on the surface.

specimen was taken on board the ship, and placed under the microscope, the whole sarcode of the animal was to be seen expanded outside of the shell, as represented in Fig. 1. When our attention was once directed to the subject, the pelagic Foraminifera were observed in almost every haul of the tow net. Many of the Globigerinae, the Orbulinae, and the Hastigerinae are furnished with long spines, and when the animal is expanded the sarcode rests between the spines. In the Pulvinulinae, the Sphæroidinae, and Pulleniae, which Stream waters which flow up the Faroe Channel, although not a single specimen was observed in the Minch or North Sea waters. The pelagic Foraminifera are truly oceanic creatures, even more so than the pteropoda; they are most abundant in true oceanic currents; where these currents flow directly toward a coast they may be borne close to the shore, but usually they are only to be met with far out at sea.

From an examination of the large number of microscopic preparations and tow net gatherings made dur-

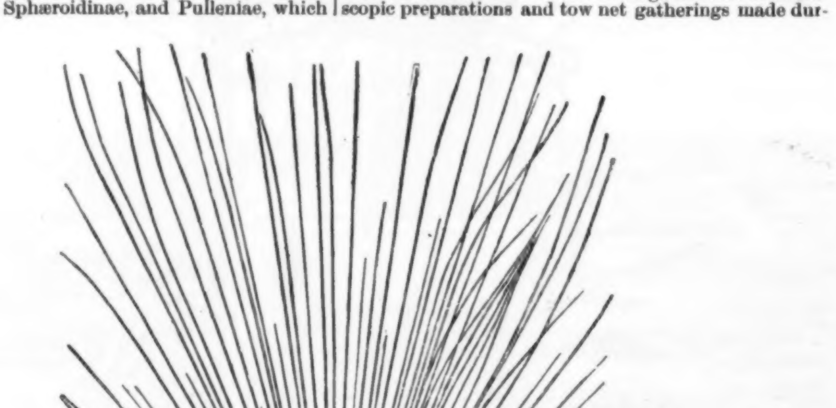


FIG. 2.—Orbulina universa (d'Orbigny), from the surface.

have no spines, the shell is frequently so hidden in the expanded yellow-colored sarcode that it may escape observation.

On the return of the Challenger expedition, the late Mr. H. B. Brady and others pointed out that, if the Globigerinae were pelagic organisms, it was a most extraordinary circumstance that no naturalist had recorded them in any of the numerous tow net gatherings about the British coasts. This, however, ing the Challenger expedition, the following species of Foraminifera have been recognized as pelagic:

Globigerina sacculifera, Brady; Globigerina aequilateralis, Brady; Globigina conglobata, Brady; Globigerina dubia, Egger; Globigerina rubra, d'Orbigny; Globigerina bulloides, d'Orbigny; Globigerina inflata, d'Orbigny; Globigerina digitata, Brady; Globigerina cretacea, d'Orbigny; Globigerina dutertrei, Brady; Globigerina pachyderma (Ehrenberg); Globigerina

* The North Atlantic Sea Bed. London, 1862; also Deep Sea Researches on the Biology of Globigerina. London, 1876.

† See Huxley's Appendix to Dayman's Report on Deep Sea Soundings in the North Atlantic made in H.M.S. Cyclops in June and July, 1857. London, published by the Admiralty, 1858.

marginata (Reuss); Globigerina linnaeana (d'Orbigny); Globigerina helicina, d'Orbigny; Orbulina universa, d'Orbigny; Hastigerina pelagica (d'Orbigny); Pullenia obliquiloculata, Parker and Jones; Sphaeroidina dehiscens, Parker and Jones; Candeina nitida, d'Orbigny; Cymbalopora (Tretomphalus) bulloides (d'Orbigny); Pulvinulina menardi (d'Orbigny); Pulvinulina tumida, Brady; Pulvinulina canariensis (d'Orbigny); Pulvinulina micheliniana (d'Orbigny); Pulvinulina crassa (d'Orbigny); Pulvinulina patagonica (d'Orbigny).

Cymbalopora bulloides * (Fig. 3) can hardly be regarded as a true pelagic Foraminifer. It was only captured in the neighborhood of coral reefs, and the curious thing about it is that not a single specimen was taken containing ordinary sarcode, similar to that observed in the other species of pelagic Foraminifera. In all the specimens the shells were filled with immense numbers of minute zoospores; these latter spread over the field of the microscope in a cloudlike swarm when a shell was broken under the cover glass.

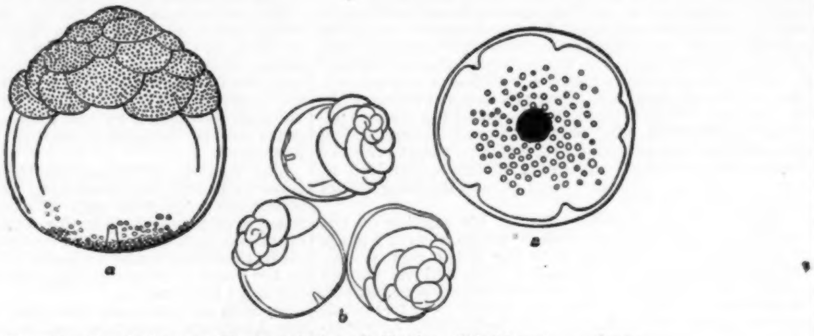


FIG. 3.—Cymbalopora (Tretomphalus) bulloides (d'Orbigny). a, large surface specimen; b, small (young) specimens from the same gathering; c, distal face of the balloon-like chamber, showing the entosolenian orifice, seated in a slight depression. All magnified 60 diam.

The usual color of the sarcode of the pelagic Foraminifera is yellowish brown. In Hastigerina it is bright red, from the presence of red colored oil globules and pigment. This red color enabled me to pick up this species with a beaker on the sea surface more easily than other species. In Globigerina bulloides (hirsuta) and aequilateralis the yellow orange color of the sarcode is due to the presence of numerous oval-shaped xanthidiæ, or "yellow cells," similar to those found in the Radiolaria. When the sarcode with these "yellow cells" flows out of the foramina, and mounts between the numerous spines outside the shell, the whole presents a very striking object under the microscope; the transparent sarcode can be seen running up and down the long silk-like spines, and the "yellow cells" seated at the base of these spines quite obscure the body of the shell.

The majority of the species in the above list occur within the tropics, and the thick-shelled species occur only in warm water, such as Sphaeroidina dehiscens, Pulvinulina menardii (Fig. 4), Pullenia obliquiloculata, Globigerina conglobata and sacculifera. The number of species becomes less in the temperate regions, Pulvinulina micheliniana and canariensis, Orbulina universa (Fig. 2), Globigerina bulloides and inflata being the prevailing forms. In the Arctic and Antartic regions Globigerina dutertrei and pachyderma, together with very minute specimens of Globigerina bulloides, appear to be the only forms present in the surface waters. The gradual disappearance of the tropical species, and their replacement by other species, as the colder water to the north and south of the equatorial regions is entered, has always appeared to me rather puzzling, especially when it is remembered that these changes take place in a continuous oceanic current, like the Gulf Stream, flowing from the equator toward the poles. It sometimes seemed as if the one form slowly passed into the other with the changed conditions of surface temperature.

The same species inhabit all the great oceans, but in the Indian and Pacific Oceans certain species appear to predominate, for instance, Pullenia obliquiloculata

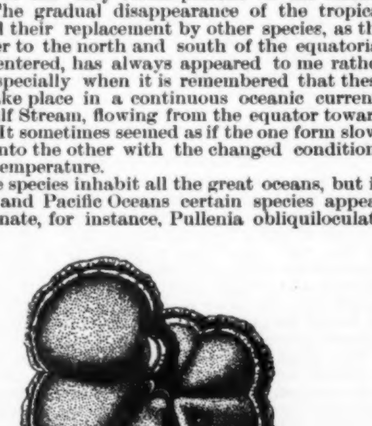


FIG. 4.—Pulvinulina menardii (d'Orbigny), from the tropical deposits.

and Globigerina aequilateralis; on the other hand, Pulvinulina menardii and Globigerina rubra appear to be more abundant in the tropical Atlantic.

The species inhabiting the north and south temperate regions and the species inhabiting the two polar regions appear to be nearly if not quite identical.

The distribution of the dead shells of the pelagic Foraminifera on the floor of the ocean corresponds exactly with the distribution of the living specimens at the surface of the sea. It has sometimes been urged that the dead shells of tropical species might be carried a long way to the north or to the south by oceanic currents, but this does not seem in any way to be the case; the distribution of the dead shells on the bottom does not appear to be much if any wider than that of the living specimens at the surface, and this shows that the dead shells must reach the bottom a very short time after the death of the organisms. The fact that the distribution of these shells at the bottom of the ocean is governed by the surface conditions is of itself almost conclusive proof that they live only at the surface, for otherwise their distribution would be similar to that of bottom living, or benthos, species, which is wholly independent of the temperature conditions prevailing at the surface of the sea. Carpenter and Brady at one time held the view that young individuals lived at the surface and adult ones at the bottom; in addition to the fact that no living specimen has ever been obtained from the bottom, the above considerations with regard to distribution show that this view is not supported by any trustworthy observations. In the surface gatherings the young individuals are much more abundant than adult ones, still shells as heavy as any in the deposits are occasionally taken in the surface nets. The young individuals are likewise more abundant at the surface than in the deposit, when compared with the adult shells present; this is especially the case in deposits from very deep water. This arises, as we shall see, from the more rapid solution of the young shells as they fall through the sea water to the bottom.

When examining a deep sea deposit it is always possible to say, from a study of the pelagic shells of the Foraminifera, whether the sample comes from the tropics, the temperate or the polar regions, but from the examination of these shells alone it would be extremely difficult to say whether the specimen was from the northern or southern hemisphere.

Off the Agulhas Bank at the Cape of Good Hope, off the east coasts of Australia and Japan, and off the east coasts of North and South America, oceanic currents from different sources meet and mix, and there is a wide range of annual temperature at the surface. In these positions large numbers of pelagic Foraminifera (as well as other organisms) appear to be killed by the sudden changes of temperature, and consequently there are indications that the deposits, so far as due to these shells, are accumulating more rapidly in these areas than in other situations. It is a curious fact also that in these regions the deposits of glauconite and phosphatic nodules are more abundant than elsewhere.

In a certain sense the course of a surface oceanic current can be traced on the bottom by means of these dead pelagic shells; for instance, the axis of the Gulf Stream is marked out by deposits of Globigerina ooze from the Strait of Florida to within the Arctic circle. No similar warm current enters the Antarctic region, and consequently no true Globigerina ooze is found to the south of lat. 50° S. When the Challenger took her first deep sea sounding after leaving Heard Island (in lat. 60° S.) there was much speculation as to what the nature of the deposit would be. I ventured to say that it would not be a Globigerina ooze, founding that opinion on the fact that only one or two small Foraminifera had been observed in the tow nets for several days. When a white colored deposit was brought on board from 1,260 fathoms the laugh was rather against "the philosophers," for in external appearance it greatly resembled the calcareous oozes of the Atlantic. On examination, however, it was found to be a Diatom ooze with only relatively few Globigerina shells.

The most striking peculiarity in connection with the distribution of these dead shells on the floor of the ocean is the fact that they are wholly absent from all the greater depths of the ocean, although at the surface their living representatives are as abundant over these deep areas as elsewhere. If we suppose a volcanic cone to rise from the greater depths of the ocean up to within 400 or 300 fathoms of the surface, it will be found that the summit of this cone is covered with a calcareous deposit for the most part made up of the dead shells of pelagic organisms. The deposit may contain 90 per cent. of carbonate of lime, and in it every species of shell met with in the surface waters of the region is represented. As we descend the sides of this cone into deeper water, the thinner and more delicate shells, like Candeina and Hastigerina, disappear first from the deposit (along with the Pteropod shells). In about 2,000 fathoms the deposit consists chiefly of pelagic Foraminifera, and the proportion of young shells is much smaller than in the deposits at lesser depths. With increasing depth the whole of these calcareous shells gradually disappear, till at 4,000 and 5,000 fathoms probably not a vestige of them can be traced, and the deposit all round the cone in 3,000 fathoms becomes a red clay with only traces of carbonate of lime in its composition. Again, if we suppose a basin-like depression on the floor of the ocean, the center of which descends to 4,000 or 5,000 fathoms, while the rim of the basin has only a depth of 1,000 or 2,000 fathoms, then, on the rim, deposits of Pteropod and Globigerina oozes will be found with 70 or 80 per cent. of carbonate of lime, while the center of the basin will be occupied by a red clay with probably not a trace of these carbonate of lime shells. The gradual disappearance of these calcareous shells with increasing depth is evidently due to the solvent action of sea water, and especially of deep sea water. In the lesser depths a very large proportion of these surface shells seem to reach the bottom before they are completely dissolved, and accumulation takes place. With increasing depth the more delicate shells are dissolved before reaching the bottom, and accumulation becomes slower and slower, the last traces of these shells observed in the deposits with increasing depth being broken fragments of large Pulvinulinae and Sphaeroidinae. The greater quantity of lime in solution which Dittmar found in the Challenger samples of deep sea water is apparently a consequence of the solution of the pelagic shells here referred to.

During the early part of the Challenger expedition, Wyville Thomson was much puzzled to account for the origin of the fine red clay which occupies the basin-like depressions of the sea bed far from land, and he suggested that this was an ash * left behind after the solution of the carbonate of lime shells. He was led to this view by observing that when the shells were taken from the purest samples of Globigerina ooze, and, after being carefully washed with pure water, were dissolved with dilute acid, a small clayey residue of a red color remained behind. I was not satisfied with this experiment, for I observed that the color of the residue varied in different samples, and it seemed to me that the fine clayey matter had infiltrated the shells after they had reached the bottom. I accordingly collected, in the course of several months, about 10 grammes of pelagic Foraminifera from the surface of the sea. When these shells were dissolved in dilute acid not a vestige of residue was observed. It was subsequently shown that the red clay came from a variety of sources, and that in the deep sea far from continents it was chiefly derived from the trituration and decomposition of floating pumice.†

During the past year or two I have carefully collected all the available temperatures of the surface waters of the ocean, and from these have constructed a map showing the annual range of temperature in different regions of the ocean. This map shows that the surface of the sea may be grouped into five great zones, viz.: (1) A nearly continuous equatorial zone, where the temperature is high and the range throughout the year does not exceed 10° F. This zone includes all the principal coral reef regions. (2 and 3) Two polar zones, where the temperature is low and the annual range likewise does not exceed 10° F. In these zones there are relatively few lime secreting organisms. (4 and 5) Two regions lying between the equatorial zone and the two polar zones, where a wide range of temperature occurs between the different seasons (the annual range amounting to as much as 52° F. in some places). In these temperate regions the secretion of carbonate of lime appears to be much more active in the warmer than in the colder months. It thus appears that the most favorable conditions for lime secreting organisms are met with in the warm, equable tropical waters of the ocean, and here as a matter of fact we find the greatest development of corals, and the largest number of lime secreting pelagic organisms. In the polar areas and in the cold water of the deep sea there is, as is well known, a feeble development of all carbonate of lime structures in marine organisms.

From experiments which have been carried out by Mr. Irvine and myself at the Granton Marine Station, we have reason to believe that this distribution is dependent primarily on the physical or temperature conditions of the oceanic waters. When carbonate of lime is precipitated by alkaline solutions, such as carbonate of soda, carbonate of ammonia, or carbonate of methylamine, the effect of temperature is very marked, and it appears to be the case that the secretion of carbonate of lime by organisms is of the nature of a fine precipitation in the interior of the soft structures.‡ If we add sufficient carbonate of ammonia to sea water at different temperatures to convert all the lime salts present into carbonate, we obtain a precipitate which varies both in its crystalline form, in amount, and in time of formation. At 32° F. the precipitate begins to form in about six hours as small but distinct crystals

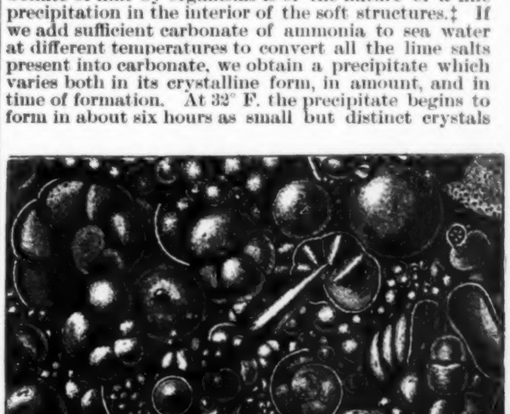


FIG. 5.—Globigerina Ooze, from 1,900 fathoms in the Atlantic. Magnified 25 diam.

of calcite, the quantity in twenty hours amounting only to 0·2 gramme from a liter of water. At a temperature of about 47° F. a mixture of calcite and aragonite is precipitated; at 80° to 90° F. the quantity precipitated is about 0·6 gramme, the precipitate begins to form in from a half to one hour, and it appears to consist of minute crystals of aragonite. It thus seems evident that carbonate of lime would be more easily and more rapidly secreted in the high temperatures of the tropics by means of the effete products of the organism.

As is well known, carbonate of lime in any form is easily soluble in water containing carbonic acid, and the aragonite form is more quickly soluble than the

* See Narr. Chall. Exp., vol. i, pp. 888-9, 1885.

* Proc. Roy. Soc., vol. xxiii, p. 45. 1874.

† See Murray, Proc. Roy. Soc. Edin., vol. ix, p. 247, 1876; also Murray and Renard, Deep Sea Deposits Chall. Exp., p. 294, 1891.

‡ Murray and Irvine, Proc. Roy. Soc. Edin., vol. xvii, pp. 79-109, 1890.

calcite form in the proportion of about three to two. Both aragonite and calcite are apparently very partially soluble in sea water which does not contain free or loosely combined carbonic acid, but when these dead shells are in contact with decaying organic matter, giving off carbonic acid, they are rapidly dissolved. An experiment with Globigerina ooze in a sea water containing additional carbonic acid showed that the thin walls of the chambers of the shells were first dissolved, leaving rings of the thicker portions of the Pulvinulina shells, for example. Decaying organic matter has a powerful solvent action on carbonate of lime, due to two causes: (1) By the carbonic acid formed as one of the products of this decay, and (2) on account of the formation of sulphides and sulphureted hydrogen, due to the reduction of the sulphides present in sea water.—John Murray, in Natural Science.

EDWARD DRINKER COPE, NATURALIST.*

I.

Bitter constraint, and sad occasion dear
Compels me to disturb your season due;
For Lycidas is dead, dead ere his time
Our Lycidas, and hath not left his peer.†

On the morning of April 13, in a car on my way from a funeral in New York to Washington, a newspaper notice of the death the day before of my old friend E. D. Cope caught my eye. Shocked by the intelligence, I dropped the paper, and memory recalled various incidents of our long acquaintance.

The threnody of Milton ‡ in commemoration of his friend Edward King also rose to recollection, and the lines just quoted seemed to me to be peculiarly fitted for the great man just dead. He was, indeed, no longer young and had attained his prime, but he had planned work for many years to come and had well advanced in the execution of some of it. He had truly died before his time and had left no peer; the greatest of the long line of American naturalists was prematurely snatched from science and from friends.

My acquaintance with Cope began in 1859. While looking through the part of the Proceedings of the Academy of Natural Sciences, of Philadelphia, for the month of April, in which my first paper published by the Academy had appeared, I found one by E. D. Cope "On the Primary Divisions of the Salamandridæ." It seems that the papers by Cope and myself had been passed on by the Committee on Publications on the very same day (April 26) and appeared in print in juxtaposition. I had not previously heard of the new devotee of science and read his article with as much interest as my own. A well equipped man had evidently come upon the field, and this was the first of the numerous articles that were destined to appear in an uninterrupted flow for nearly four decades. A few months afterward I met the author in Philadelphia at the Academy. A young man, nineteen years old, about five feet nine or ten inches high, with head carried somewhat backward, and of rather robust frame, stood before me. He had an alert, energetic manner, a pronounced, positive voice and appeared to be well able to take his part in any trouble. His knowledge was by no means confined to herpetology, but covered a wide range of science, and his preliminary education had been good. We afterward met from time to time in Philadelphia and Washington, and found we had many sympathies in common and some differences.

In one of our first interviews we had quite an argument on the nature of the family group in zoology, resulting from criticisms I made on the extended scope he had given to that category in the classification of the salamanders. Another controversy, I remember, had reference to the vertebral theory of the skull. In an article on the venomous serpents, published in the Proceedings of the Academy for 1859, he had defined the group in terms involving the adoption of that theory, and I ventured to dissent from its reality. I had myself been much impressed with it in former days, and when sixteen years old had copied in colors an illustration of Owen's so-called archetype reproduced in Carpenter's Physiology. Subsequently, however, the fact that there was only an approximation to the realization of it in the most specialized of fishes and not at all among the lower or higher vertebrates, with other considerations, turned me from it, and I gave my reasons for dissent to Cope. Ultimately he admitted the force of the argument and also abandoned the theory at one time so popular in England and America.

Our acquaintance thus begun in 1859 continued uninterruptedly till death divided us. We rarely met, indeed, that we did not express difference of opinion respecting some subject, but the difference was never of a serious nature and generally little more than sufficient to enliven intercourse.

The future naturalist was born in Philadelphia on July 28, 1840, and the name Edward Drinker was given to him. He was the descendant of a prosperous line long established in Pennsylvania. His father, Alfred, was a man of cultivated literary taste and did much to train his son's mind in early youth. He had retired from active business and lived in luxurious ease in Germantown, a suburb of Philadelphia. There he had formed an arboretum containing most of the American trees which would thrive in the climate of that region. Amid such surroundings the youthful Cope grew up.

An active and intelligent interest in nature became manifest at a very early age. When only about seven years old, during a sea voyage to Boston with his father, the boy is said to have kept a journal which he filled with drawings of "jelly fish, grampuses and other natural objects seen by the way." When eight and a half years old he made his first visit to the museum of the Academy of Natural Sciences of his native city; this visit was on the "21st day of the 10th month, 1848," as entered in his journal. He brought away careful drawings, measurements and descriptions of several larger birds, as well as of the skeleton of an ichthyosaurus. His drawing of the fossil reptile bears the explanatory legend in Quaker style: "two of the sclerotic plates look at the eye—thee will see these in it."

At the age of ten he was taken upon a voyage to the West Indies.* What were the impressions he derived from that voyage we have not been told. But what has been communicated amply justified Professor Osborn in his declaration that "the principal impression he gave in boyhood was of incessant activity in mind and body, reaching in every direction for knowledge, and of great independence in character and action." His school education was mostly carried on in the Westtown Academy, a Quaker institution about twenty-three miles west of Philadelphia. One of his instructors was Dr. Joseph Thomas, a well known literary worker of Philadelphia and future author of a "Universal Pronouncing Dictionary of Biography and Mythology" (1870), and said to be an "excellent linguist." Under his guidance Cope obtained a passing knowledge of Latin and Greek. He appeared to have had no instruction in any biological science and had no regular collegiate training. He did, however, enjoy the advantage of "a year's study (1858–59) of anatomy and clinical instruction at the University of Pennsylvania," in which the illustrious Leidy was professor of anatomy. But, in the words of his literary executor (Professor W. H. Osborn), "it is evident that he owed far more to paternal guidance in the direct study of nature and to his own impulses as a young investigator than to the five or six years of formal education which he received at school. He was especially fond of map drawing and of geographical studies."†

While a school boy he relieved his studies of the classics and the regular course in which boys of his age were drilled by excursions into the fields and woods. Reptile life especially interested him, and he sought salamanders, snakes and tortoises under rocks, stones, fallen trees and layers of leaves, as well as in the ponds and streams of his vicinage. The trophies of his excursions were identified from descriptions in the works in which they were treated, as well as by comparison with identified specimens in the museum of the Academy. He early and almost without guidance learned to use the library and collection of the Academy, although he did not become a member until he came of age in 1861.

Cope's first contribution to the Proceedings of the Academy appeared in the part covering April and was "On the Primary Divisions of the Salamandridæ, with Descriptions of the New Species."‡ In this maiden paper he instituted important modifications of the systems previously adopted in the United States. He soon afterward catalogued the serpents preserved in the museum of the Academy of Natural Sciences and likewise improved upon the systems previously in vogue. He continued with various papers, describing new species and giving synopses or brief monographs of sundry genera of lizards and anurous amphibians.

For five years his publication was confined almost exclusively to the reptiles and amphibians. (The continuity was only interrupted once, in 1862, when he described a new shrew caught by himself in New Hampshire.) Not until 1864 did he begin to extend his field. In that year he described various fishes and a supposed new whale, and gave his first contribution to paleontology in the description of the stegosaurian amphibian called Amphibamus grandiceps. But although his attention had become thus divided, he never lost his interest in herpetology and continued to the end of his life to devote much attention to that department. His studies extended to every branch of the subject, covering not only specific details and general taxonomy, but also the consideration of anatomical details, the modifications of different organs, geographical distribution, chronological sequence, genetic relations and physiological consequences. So numerous were his memoirs, so entirely did he cover the field of herpetology, and so marked an impression did he make on the science, that he was well entitled to apply to himself the boast of the Virgilian hero, "Pars magna fui."

In his earliest essays he manifested the independence and critical spirit which were so characteristic of him later. One knowing all the circumstances of the case may be amused in coming across a passage expressed in the tones of a veteran published by him when twenty years old: "In proposing the name Zaocys . . . we are giving expression to an opinion long held by us as to the unnatural association of species in the so-called genus Coryphodon. . . . In it we find cylindrical terrestrial species united with compressed subarboricole species, upon a peculiarity whose value as an index of nature appears to us entirely imaginary. The very nature of the coryphodontian type of dentition, as distinguished from the isodontian and syncranterian, would lead us to infer its inconstancy;" and so on.§ Bold as was the criticism of such herpetologists as Duméril, Bibron and Günther, it was justified by the facts, and the young author's conclusions have received the indorsement of the best succeeding herpetologists, including even the latest author criticised.

In 1863 he paid a visit to Europe, partly for the benefit of his health, which had suffered from overwork, and partly for the purpose of seeing the great museums of England, France, Holland, Austria and Prussia. Notwithstanding his ailments, he made good use of his time abroad and systematically examined the collections of reptiles in the chief centers of science. He did not even restrict his studies to herpetology, but extended them to various other subjects.

On his return from Europe, in 1864, he was appointed professor of natural science in Haverford College, an institution chiefly supported by Quakers, but retained the position only three years. During this time, in 1865, he married Miss Annie, daughter of Mr. Andrew Pim, of Chester County, Pa.

In and after 1864, too, he enlarged the range of his studies and publications, and also extended them to ichthyology, mammalogy and paleontology. He had always been interested in the philosophical aspects of science and early adopted the conception of descent with modifications to account for the variations of animals and the differentiation into species and higher groups, and in 1869 began to give expression to his peculiar views.

On the death of his father he became heir to a considerable fortune. Part of this was invested in mines, which for a short time gave promise of good returns, but, it is said, the majority of the stock was held by others, and owing to the incapacity of superintendents and the operations of the controlling stockholders he lost his interests. While in the enjoyment of his fortune he spent large amounts in collections and personally conducted or sent out expeditions to various places. One of the most important was sent to South America. He filled a large house from cellar to topmost story with his collections and resided in an adjoining one.

In 1871 he conducted an expedition to Kansas and especially investigated the Cretaceous beds of that State and collected their fossils. In 1872 and 1873 he became connected with the United States Geological Survey, and for the fossils visited Wyoming in the former year and Colorado in the latter. In 1874 he joined the survey under the command of Lieutenant Wheeler, of the engineers, and explored New Mexico.

The collections made during these expeditions were large, and the unwearied industry and energy, as well as cares, of Cope were rewarded with many well preserved fossils. These were described in many communications to the Academy of Natural Sciences and the American Philosophical Society, and later in large volumes published by the general government as reports of the respective surveys with which he was connected.

The various investigations thus opened were continued through the succeeding years. His collections continued to grow in spite of reduced means. He refused even to sell portions for which he was offered liberal sums and, at the cost of personal discomfort, held on to them and made his home, for much of the time, in the midst of them, having sold his residential house but kept his museum.

In 1878, he purchased the rights of the proprietors of the American Naturalist and removed it to Philadelphia. Professor Packard, one of the original proprietors, co-operated with him in the editing of it for some years and he was also assisted by various eminent specialists.

In this journal numerous articles of all kinds, including reviews and editorial comments, were published by him. His last words appeared in numbers issued after his death, the leading article in the number for June having been written shortly before his death. It treats of the remarkable mammals of South America known as Toxodontia.

(To be continued.)

* Presidential address by Prof. Theodore Gill before the annual meeting of the American Association for the Advancement of Science, August 9, 1897.

† In the extract from Milton's poem time has been substituted for prime and our for young.

‡ Milton, poems xvii.

* Osborn in Science, N. S., v, 706.

† Osborn.

‡ Proc. Acad. Nat. Sci. Phila., 1859, pp. 122-128.

§ Proc. Acad. Nat. Sci. Phila., 1860, p. 563.

THE COMMON ACCIDENTS OF SUMMER TOURISTS.

By James E. Pilcher, M.D., Captain in the Medical Department of the United States Army.

FOREIGN BODIES.

In camping parties particularly, insects are liable to find their way into the auditory meatus and produce great annoyance and sometimes no little pain. It will do no harm to hold a bright light to the ear in the hope that the intruder may be attracted to emerge, but it is better that every person should know how readily foreign bodies can be floated out of the ear by injections of warm water.

The eye is even more subject to travel accidents of this kind than the ear, and unless the body be embedded in the cornea or conjunctiva, which is comparatively unusual, no emergency is more readily relieved. There is no reason why the laity should not understand the simple maneuver of exposing the lining of the lower lid by looking up, while gentle pressure is made just below the eyelid. The drawing of the upper lid down over the lower is equally easy and often effective in removing the foreign body. In case of failure, the removal may be attained by drawing across the eye, under the upper lid, a little corner of a very soft linen handkerchief moistened with the patient's saliva. Sufferers from this accident should be informed that a slight conjunctival abrasion, produced by a foreign body which has been removed, will continue the sensation of the presence of the body even after it has disappeared.

CUTANEOUS ACCIDENTS.

The burns of the stage of rubefaction and sometimes of slight vesication, produced by the exposure to the rays of the sun of persons unaccustomed to outdoor life, are common to summer tourists. The recognition of the fact that this accident is a genuine burn renders its treatment readily understood. The numerous cold creams and other unguents sold in the apothecary shops serve well enough, but nothing can be better for general use in these cases than the carbolated petrolatum everywhere available.

The same may be said of the lichen tropicus or "prickly heat," to which delicate skins are subject in hot weather. The intense itching of this trifling but exceedingly annoying affection is also usually readily brought within the limits of endurance by carbolated applications. The little jar of carbolated petrolatum is a most advantageous constituent of every tourist's summer outfit.

The more severe inflammation produced by contact with the various species of rhus, the "poison ivy," the "poison oak" and the "poison sumac," is often temporarily treated with advantage in the same manner. These injuries, however, pre-eminently come under the category of matters in which the "ounce of prevention" is particularly applicable, and it is well for persons going into the country for an outing to be able to distinguish them from the harmless growths which they resemble.

The beautiful woodbine or Virginia creeper is distinguished from the venomous "poison vine" by the fact that the leaf of the harmless growth consists of five leaflets given off from a common stem, while that of the toxiferous plant has but three leaflets upon the main stem. The "poison oak," or Rhus toxicodendron, may be detected by the same conformation of leaf. The "poison sumac" or Rhus venenata, which produces a cuticular inflammation similar to those already mentioned, may be distinguished from the ordinary harmless sumac by the fact that, instead of bearing close bunches of red berries at the ends of its branches, its fruit consists of slender clusters of small white berries given off from the axils of the leaves.

WOUNDS.

It is difficult to realize that in this day and genera-

tion any person can be so ignorant as to treat slight wounds with anything but cleanliness and gentle pressure. But the cobwebs, tobacco quid and filthy mud heresies all still have enthusiastic partisans, and slight wounds are exceedingly liable to be transformed into poisoned wounds of considerable extent by the employment of such agents. It is well then to impress upon the traveler the fact that in the wounds of no severity simple cleanliness and gentle pressure, maintained by a clean compress held by a clean bandage, comprise all the requisite treatment. It is worth while indeed to go farther and explain that filthy agents should be eschewed in any kind of wound. Why fresh cow dung or dust permeated cobwebs should be considered to possess healing qualities is a question that the wisest cannot answer. But, with the predilection for those dressings which possesses the bucolic mind, it is a most wise precaution to warn contemplating travelers against them and in favor of clean applications, and to explain that anything contaminated with animal secretions is dangerous, from the mucus laden handkerchief to the sweat saturated shirt—clean paper being better than soiled linen, the ink of the printed sheet being rather an advantage than otherwise. The removal of a barbed fishhook by thrusting the point out through the skin, and then, after breaking off the barb, easily withdrawing it, is so simple a procedure that it seems hardly necessary to mention it, but experience has shown how few of the uninitiated bethink themselves of this very natural maneuver. It should also be understood that the temporary treatment for severe wounds, after checking hemorrhage and placing the parts in a comfortable position, is identical with that for slight ones.

BLEEDING.

The most alarming feature of the more severe wounds is the bleeding, which, in case of an injury to an artery, may be dangerous to life. Every person should understand the difference between arterial, venous and capillary bleeding. The bright red hue and spurting flow of the wounded artery should be recognized as an indication of danger promptly to be treated. The fact that pressure between the wound and the heart will control such bleeding should be impressed on every mind. The simple construction of a tourniquet from a large handkerchief, a bit of a garment, a suspender, or any simple article which can be bound firmly about a limb, and the method of tightening the bandage thus created by thrusting under it a rod of any kind and twisting it until the pressure exerted checks the bleeding, should be a part of the elementary knowledge of every one. To this should be added the fact that firm pressure directly upon the wound, in other than arterial bleeding, is the proper method of restraining the hemorrhage. The laity should be cautioned, however, to immediately apply pressure with the hands directly upon the wound, even in case of an arterial injury, until the extemporized tourniquet can be put in place. Death has been known to occur from an arterial wound while the amateur surgeon was so much interested in manufacturing his tourniquet that he neglected to control the bleeding in the meantime.

FRACTURES.

Some points with regard to fractures may be of the greatest value to the summer tourist—the main point being aptly expressed in the Latin motto, noli me tangere. Fractures and dislocations are so frequently aggravated by meddlesome handling that the dictum to do nothing more than place the injured part in the most comfortable position possible for the patient and retain it there, should be most emphatically impressed upon the lay mind. Extemporized methods of immobilizing the parts in the easiest position should be generally understood, including the utilization of canes, umbrellas, sticks and the like as temporary splints to prevent the accentuation of the pain and the aggravation of the injury by motion at the point of fracture.

SPRAINS

are sometimes fully as painful and disabling as fractures, and, like fractures, they should not be made the object of unnecessary meddling. No injury is more frequent with the summer tourist than the sprain, particularly of the ankle. The mode of vacation life, with its admixture of athletic sports and unaccustomed exercise, particularly predisposes to this accident. The laity should learn to avoid arnica, turpentine, and other abominations in favor of immediate immersion in hot water for a considerable period, followed by elevation of the extremity and gentle retention of the parts by a bandage, the material for which may well consist of elastic flannel.

HEAT STROKE

or heat prostration is one of the more frequent results of exposure to unexpected exercise in summer traveling. It is well for tourists to understand the danger of prolonged exposure to the sun in very hot weather. The use of alcoholic stimulants or the drinking of water in excess should be avoided before going out, and the advantages of applications of cold water to the head in these cases should be well understood.

DROWNING.

As the water enters largely into the plans of summer excursionists, the list of summer casualties naturally presents a large number of cases of drowning. While the great majority of these cases are beyond recovery before the body is taken from the water, there are still many in which artificial respiration, persistently and effectively applied, may restore the pulmonary and cardiac action. The Sylvester method is the most popular, consisting—the patient lying upon his back—of alternate contraction and expansion of the chest, by alternately pressing the arms upon the chest and raising them strongly over the head, from twelve to fifteen times a minute, all this of course after the water in the air passages has been emptied by gravitation. The best authorities believe that artificial respiration is often too soon discontinued, and advise that it be persisted in for from thirty minutes to an hour. It should be remembered that the body, until the lungs become filled with water, is buoyant and will float, not high up, but still with its upper surface above the water; and the addition of the merest trifle of assistance, such as is afforded by a small board, not to speak of an oar or larger floating body, will enable the head to be kept well out of the waves. If, then, one can have self-possession in the very disconcerting moment of submersion, he may be able to keep himself afloat until aid can arrive, or possibly until he can reach the shore unaided.

There are many other points in first aid, easily acquired and readily remembered, the application of which may not only contribute greatly to the comfort and ease of the ill and injured, but will also materially assist the practitioner in his future treatment of the case, should the accident require the ultimate action of a physician; but those here mentioned are perhaps of the greatest importance to the summer tourist. The whole subject is an important one, however, and the question of general instruction in connection with it is coming to be recognized as of steadily increasing consequence, while the number of persons qualified to stand in the breach in emergency is constantly growing, all of which is destined to result in a great saving of suffering in future injuries and a vast diminution in the mortality of future accidents.—Medical Record.

A NEW LAW OF HEREDITY.

THE truth of a law of heredity proposed by Mr. Francis Galton has been verified in particular instances, in a memoir* read by him before the Royal Society on June 3.

He first put forward the law, with hesitation, in his book "Natural Inheritance" (Macmillan & Company, 1889), page 134, because it was founded at that time almost wholly upon a priori grounds. Now, being found to hold good in a large group of cases, there is strong reason for its acceptance, as applicable generally to all qualities in all the higher (bisexual) animals. When it is applied to individual cases, minor corrections should, of course, be made in respect to sexual limitations, prepotencies of particular ancestors, and the like.

The law shows the proportion of the heritage that is contributed on the average by each parent, grandparent, great-grandparent, and so on. There must be an average contribution, drawn from each ancestral place independently of all the rest, because cases are familiar to observers in which a peculiarity found in some single ancestor has appeared in one or more of the offspring; the present law expresses its amount.

The general considerations upon which the law was originally founded are four in number, but not equally cogent; there is only one solution that satisfies them all. (1) The consequence of limitation in space on particulate germinal matter, which necessitates the loss of one-half of the total germinal material contributed by the two parents. This is confirmed by the commonly (though not universally) accepted fact of observation in the life history of the germ. (2) The remark already made, that any ancestor however remote may contribute his peculiarity independently of the rest. (3) The contribution of the two parents to the child, being analogous to that of the 4 grandparents to the 2 parents, of the 8 great-grandparents to the 4 grandparents, and so on, make it probable that the latent links of the chain of ancestral contributions form a geometric series of terms, diminishing as we proceed from the ancestor downward. (4) The sum of the contributed heritages must be equal to 1.

These four conditions are satisfied by the series $\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} +$ etc. In other words, by the supposition that the two parents contribute between them $\frac{1}{2}$ of the total heritage of the child; the four grandparents, $\frac{1}{4}$; the eight great-grandparents, $\frac{1}{8}$, etc. Or again, that a single parent contributes $\frac{1}{4}$; a single grandparent, $\frac{1}{16}$; and a single ancestor in the nth generation $1/2^{2n}$. A noteworthy consequence of this is that all the 16 great-great-grandparents taken together are no more efficient than a single grandparent, and only one-quarter as efficient as a single parent.

This supposition does not run counter to the commonly accepted view that the true line of descent stretches from germ to germ, and not (except in, perhaps, a small degree) from person to person; the person must on the average be a fair average representative of the germ; consequently statistical averages which are true of the one would be true of the other also.

The verification of the above theory is the object of Mr. Galton's memoir. Appropriate materials for the purpose were at last found in the registered colors of the pedigree stock of Basset hounds. This stock was started some twenty years ago by Sir Everett Millais, who purchased on the Continent 93 selected hounds for the purpose, and has subsequently interbred their most valuable descendants. A Basset Club has long been established, which publishes an occasional stud book (the latest was in 1896) containing the registered name, parentage, date of birth, and breeder of each hound. The colors are not printed in it, but they are always entered on the form sent by the breeders to the club, and Sir E. Millais kindly had them copied for his use. Now there are two, and only two, recognized varieties of these colors: the one technically known as lemon and white (the word "lemon" standing for any shade between yellow and reddish-brown), and the other known as tricolor, from its containing black as well. So there are only two alternative conditions to be considered: "with black" and "without black;" or "tricolor" and "non-tricolor"—say for brevity, T. or N. It is asserted that intermediate and doubtful cases between T. and N. hardly exist.

The result is a collection (1) of 817 hounds of registered colors, T. or N., descended from parents whose colors are also known. (2) Of these, in 567 cases, the colors of all four grandparents are known; again (3) of these, in 188 cases, the colors of all eight great-grandparents are known. These three sets form the material that is tabulated and discussed, and supplies the requisite means for comparing calculated results with observed ones.

There are numerous points dealt with in the memoir, and explained away, of which there is not space to speak of here; one only need be mentioned, namely the question whether either the sire or the dam is so prepotent in transmitting color as to make it necessary to treat the sexes apart. It proves that the dam is prepotent over the sire in this respect, but only in the proportion of 6 to 5; also that the neglect of sex made no sensible difference in a test case. Consequently all ancestral places in the same generation are treated as of equal average efficiency. In short, if n be the order of any given generation (counting n = 1 for parents, = 2 for grandparents, etc.), there are 2^n ancestral places in the nth order, and these contribute between them $1/2^n$ of the total heritage; consequently each ancestral place contributes $1/2^{2n}$ of it. If the same hound fills more than one ancestral place, he has to be rated separately for each of them.

The contributions from the unknown ancestry are reckoned as follows: It was found that 79 per cent. of the parents of T. hounds are T. also, and that ·56 per cent. of the parents of N. hounds are T.: consequently the unknown grandparents, great-grandparents, etc., of the T. hounds would have probably $(0·79)^2$, $(0·79)^3$, etc., of T., and those of the N. hounds would have $(0·56)^2$, $(0·56)^3$, etc., of T. A simple calculation shows that the sum of the T. contributions to the offspring of the unknown ancestry of each T. grandparent would be 0·0408, and that of each N. grandparent would be 0·0243; these values are used in discussing the set (2). In set (3) the great-grandparents are known, ignorance beginning above that stage; in this case, the pre-ancestral contribution of T. through each T. great-grandparent is found to be 0·0102, and that through each N. great-grandparent is 0·0061. There is no need here to allude to minor corrections, noticed in the memoir, whose effect is too small to be worth regarding.

It thus becomes a very simple matter to determine the contribution from each several known ancestor as well as that from the unknown ancestry of each of them, and, by adding these together, to obtain a coefficient appropriate to any given group of similar cases, such as, when multiplied into the total number of offspring, shall give the "calculated" number that are T.

The test of the truth of the theory lies in the accordance between these calculated numbers and the observed number.

Owing to the large proportion of T. hounds and to selective breeding in favor of T., the different possible matings are by no means equally common, those in which the known ancestry are all (or nearly all) N. being non-existent. The results for such as occurred are summarized below (excluding seven cases, falling into three groups, that lay outside the limits of the table for set 3). The coefficients are added to show the degree of variety in the test conditions. Fuller information is to be found in the tables published in the memoir, out of which these figures are extracted:

CALCULATED AND OBSERVED VALUES COMPARED.

Set 2

Coefficient...	·91	·83	76	·68	·66	·58	·51	·43	·26	·18	—	Total
T. calculated	108	99	21	8	24	92	30	3	5	1	—	391
T. observed	106	101	24	8	20	79	36	4	7	2	—	387

Set 3.

Coefficient...	96	94	·92	·90	·87	·85	·83	·81	·81	·79	·77	
T. calculated	2	24	13	14	16	18	13	5	2	3	2	(continued)
T. observed	2	25	14	15	17	19	14	6	2	2	3	

Set 3 (continued).

Coefficient...	·75	69	·67	·65	·64	·62	·60	·58	·56	·54	·52	Total
T. calculated	2	1	1	6	1	17	8	18	5	2	7	180
T. observed	2	1	0	5	1	16	12	8	9	1	7	181

Comparing the totals of each of the two sets, we see that the calculated results are practically identical with the observed ones, 391 with 387; 180 with 181; grand total, 571 with 568. There is therefore no constant error, the errors in individual cases balancing one another. When we examine the several groups, 32 in number, which contribute toward the above totals, a remarkable amount of agreement is shown throughout between calculation and observation, such as would raise the art of breeding to a science of considerable precision. The most notable exception is in the sixth column of set 2, where the numbers are 92 and 79, but, as is shown in the memoir, the observed values run there so irregularly with their neighbors that they cannot be accepted as true representatives. The causes of heterogeneity undoubtedly include the disturbing effects of close interbreeding, because particular hounds of good shape that have also considerable prepotency are largely bred from.

The author mentions that he had made experiments with the coefficients, altering them slightly and recalculating, and that he found in every case a notable diminution in the accordance between calculation and observation; the test that the law has successfully undergone thus appears to be even more severe and searching than might have been anticipated.

It is hardly necessary to insist on the value to breeders of a trustworthy law of heredity. Vast sums are spent annually in rearing pedigree stock of the most varied kinds, such as horses, cattle, sheep, pigs, dogs, and other animals, besides flowers and fruits. Certainly no popular view at all resembles that which is put forward and justified in Mr. Galton's memoir, which is epitomized here so far as space admits.—Nature.

CLAY INEBRIATES.

IN some sections of the country a number of people are found who daily use clay as an article of food.

It is used so ravenously and with so much relish, and its effects are so marked, that it can be called a veritable inebriety. The clay eaten is of dirty white color, and has a particular oily appearance and does not crumble, but becomes sticky when moistened. It is held in the mouth until it dissolves, and is swallowed in small quantities. It evidently possesses some nourishment, and the opinion prevails that persons can subsist on it for days without any other food. The

* "The average contribution of each several Ancestor to the total Heritage of the Offspring," by Francis Galton, D.C.L., Sc.D., F.R.S.

quantity used varies largely from two ounces to several pounds a day.

There is a strange fascination which, like the diseased craving for narcotics, demands so much of this clay every day.

When, by accident or design, the supply is cut off great restlessness, anxiety, and intense depression follow. The effect of clay eating is noted on young persons by blanching the skin, giving it a peculiar pallor, and soon a prematurely old, wrinkled look. The mind seems to be depressed and under a cloud, and all vivacity and emotionalism reduced to a low level.

General muscular indisposition to exertion and indifference as to the consequence of acts and the possibilities of the future are the symptoms in adult clay-eaters. Whisky drinking, tobacco smoking, chewing, dipping, and snuffing are common accompaniments.

All ambition to improve their surroundings and add to the mental pleasures of life is absent, and profound general depression prevails. Superstitious hallucinations and fears of the supernatural, with efforts to interpret every unusual event in nature, and the most primitive struggles to supply the common wants of the body, constitute the whole of life.

Very little sickness follows, and after years of this addiction some acute disease of the stomach or liver is followed by death.

These people occupy some of the mountain counties of the Southern States, and seem satisfied to live in the poorest sections of the country. They are content to live isolated, and by farming, hunting, and fishing make a living.

The craze for the clay used is remarkable for its persistence and tenacity. The supply for daily use is provided with more energy and precision than food.

The skin of clay inebriates soon becomes of a dirty yellow color, and never changes during life. Tobacco using seems to be more closely associated with this addiction than spirit drinking. No change ever takes place except death. They cling to the same ways of life and living, never increasing the amount of clay used to any extent from one generation to the other. Both body and mind slowly retrograde down through degrees of dementia to death.—Quarterly Journal of Inebriety.

THE FOUNTAINS AT THE HOFBURG IN VIENNA.

Two magnificent sculptures were recently unveiled in Vienna (Austria). The façade of the Hofburg there has been restored, and, as of old, forms a semicircle bounded on either side by beautifully crowned wings. At this place the two fountains are raised, bringing out with great force and beauty the originality of the ancient architecture. They bear their white figures on a ground of dark brown marble and represent, respectively "Power at Sea" and "Power on Land."

On the right hand side of the semicircle is the fountain whose figures represent in their powerful allegory "Power on Land." This work of art was designed by Hellmer. The mass of the monument rises artistically in a triangle, at the vertex of which a youth, the type of power, stepping forth from the niche, drives back the powers which threaten from below. One monster, clutching the flowers that adorn the throne, in terror shrinks back, and looks with awe on the conqueror. The second demon falls headlong from the rock, while another makes vain attempts to unbalance the rocks, which, piled up, support the ruler. An eagle with extended wings defends the throne, heedless of the serpent, which is the symbol of treachery, creeping up the rock.

Edmund Hellmer has hitherto shown a liking for the antique, and has dealt largely with wild scenes, as we find them in the beautiful figures and inspired groups of the monument in memory of the rescue of Vienna from the Turks. It would scarcely have been thought that he would render with such clearness the expression of Titanic force. Whoever knows the lightly draped garments on Hellmer's splendid monument, its resplendent armors of the time of the Turks, its heroes of the rescue, scarcely imagines that the hand which carved so bright and lovely a scene could represent crude force in a composition which would fit so aptly with that of Weyr, the artist by whose hand the other fountain was fashioned, and who is accustomed to the treating of such themes. It is clear that he has even surpassed his former productions by this work, and though he is not so full of variety and so picturesque as Weyr, yet he knows how to shape his sculpture uniformly, forcibly, and so as to carry its meaning well. Not quite up to Weyr's level is the statue of the youth.

Though full of the nobility of his character and distinctly great in the expression of his face, the silhouette of this Apollinic figure is not without some faults. Yet it aptly crowns the interesting group which must be reckoned among the most deserving productions of art in our times.

Edmund Hellmer was born at Vienna in 1850, and obtained a government prize as pupil at the academy there. He is now professor at that institution. Nearly all young sculptors of Vienna have passed through his school, or have attended it before going to foreign colleges. Johann Tadrusz, the designer of the "Maria Theresa" monument, and Th. F. Ries, a young Russian sculptress, have lately made their names known in all lands as pupils of Edmund Hellmer.

The other fountain, as we have said, represents "Power at Sea" and is the work of Weyr. A master in decorative plastic art, he has for the first time used his great talent in the service of that artistic effect which must be studied closely, intelligently and into the smallest detail. His productions have so often come to public notice as flowing silhouettes on the gables of buildings that there was naturally some wondering expectation to see how he would fashion these groups, that might as it were be touched, who had hitherto shown such remarkable ability in calculating his playful lines for splendid distance effect. He has solved the problem in a truly wonderful way. The architectural motives, the muscular body of ancient Neptune, who, the trident in his right, looks with amazement on the genius, half man, half fish, falling over the rocks, and the artistically effective Moloch, are grouped in powerful unison beneath the queenly figure which crowns the group. This sculpture, a "Power at Sea," occupies the left niche in the façade. The momentous motion of the combined impressions of this masterpiece, the right side of which, with the fallen demon, is wonderfully conceived, is extremely pleasing to the eye, and gives testimony of virtuose ability in the composer.

The idea of impotent power could not better be depicted than by this work. Technically of great merit are the torso of Neptune and the breast of the crowning figure; a very modern criticism might, however, find fault with the somewhat conventional attitude of arms and legs. In this work Professor Rudolf Weyr has presented his best efforts, and the result is so great that it surpasses the production of most of the Vienna artists.

Weyr was born in 1847, was pupil of the Vienna academy, is known specially for his frieze the "Bacchantes" in the new Burg Theater, the excellent bas reliefs on the "Grillparzer" monument, and for numberless tomb sculptures.

His reputation made him well worthy to add to the plastic decorations of the great Austrian capital.

We are indebted for the views of these fine specimens of the plastic art to the German paper Ueber Land und Meer.

POWER ON LAND.

POWER AT SEA.

SCULPTURED FOUNTAINS AT THE HOFBURG, VIENNA.

DOES TRACK SWEEPING PAY?

We venture the opinion that, if more managers would look carefully into the matter of clean tracks versus dirty tracks and the cost of sweeping versus the cost of power, sweepers would be used more liberally than they are now, or at least more track brushes would be used, says the Street Railway Review. Since street railways must be operated in all kinds of streets and since municipal management often decrees that streets must remain dirty for want of street cleaning funds, the only loophole of escape for the manager is to clean his portion of the street himself. The question then arises as to how much sweeping and cleaning is justified by the return therefor in dollars and cents. One concrete example will give some idea of the economy of running a sweeper over tracks once a day, where there is moderately heavy traffic. A double track route 5 miles long, running cars at 5 minutes' headway, at 8 miles per hour for 10 hours of the day, and cars at 10 minutes' headway 10 miles per hour for 8 hours of the day, will require 15 cars during 10 hours and 6 cars for 8 hours of the day. The total mileage during the 5 minutes' headway hours is equal to the 15 cars in service multiplied by 8 miles per hour multiplied by 10 hours, or 1,200 car miles. Adding to this the mileage made by six cars running 10 miles an hour for 8 hours, or 480 car miles, the total daily mileage will be 1,680. Assuming that power costs 1 cent per car mile with a clean track and

the power to run that route costs $16.80 per day, a dirty track may easily make this 20 per cent. more, making the amount to be charged to dirty track $3.26. To run a sweeper once over that route each day would take the time of two men for about one hour, making cost of labor about 40 cents, and allowing 3 cents per mile for power to run the sweeper, we have 30 cents more, or a cost of 70 cents per day to run the sweeper once over that one route to save $3.26. This, of course, does not include sweeper maintenance, but neither does the other calculation include car wheel, track and motor maintenance. The amount saved relative to the cost of sweeping decreases as the traffic gets lighter, but there is a considerable margin of economy in favor of the sweeper, even allowing for a considerable decrease of traffic. Besides this, there are track brushes to fall back on in case it does not pay to run a sweeper, and in many cases sufficient sweeping can be done by a special attachment to one or two cars.

THE BRITISH BATTLESHIP RENOWN.

The recent naval review at Spithead brought together the most interesting types of war vessels, both British and foreign. The vessel which we illustrate is her Majesty's first-class battleship Renown, 12,350 tons. It was built at Pembroke Dock Yard, from the designs of Sir W. H. White. She is in many respects similar to the Prince George, which we have already described. For our engraving we are indebted to The Engineer and for our description to Brassey's Naval Annual. The Renown was laid down in Pembroke Dock Yard in February, 1893, and was launched in May, 1895. As already stated, she is 12,350 tons displacement, and her estimated speed, with 12,000 horse power, was 18 knots. The machinery of the Renown is by Messrs. Maudsley, Sons & Field. Great interest was attached to the trials of the Renown, as she was expected to prove herself the fastest battleship afloat. This she has succeeded in doing by a very narrow margin over the Victorious, but the latter was tried at considerably less than her load draught. At the trial it was found that for a period of eight hours under natural draught the engines made 97·8 mean revolutions; the mean indicated horse power was 10,708; her speed was 17·9 knots. Under four hours' forced draught the mean number of revolutions was 104·5, the mean indicated horse power was 12,901, the speed was 18·75 knots. On the thirty hours' coal consumption trial the mean draught was 26¾ feet and the mean speed 15·3 knots with 6,189 horse power and 86·9 revolutions. The consumption of coal was 1·88 pounds per I. H. P. per hour. The Renown is protected on the same principle as the Majestic class. The thickness of the barbette armor is 10 inches as compared with 14 inches, and of the side armor 8 inches and 6 inches as compared with 9 inches throughout. The main armament consists of four 10 inch guns as compared with four 12 inch guns. All the 6 inch quick fire guns are mounted in casemates, but only ten are carried instead of twelve. On the gunnery trials the 10 inch barbette guns were fired thirty degrees before or abaft the beam, as the case might be; they were also fired simultaneously directly fore and aft with full charges and at 35 degrees elevation without injuring the ship or the mountings.

The cost of the Renown was about $2,750,000.

The first direct mail connection across the Sahara has lately been completed. It runs from Senegal via Timbuctoo to the north.—Uhland's Wochenschrift.

TOWNS' WATER SUPPLY AND ITS DISTRIBUTION.*

By W. M. Watson, Toronto.

It is a crime to supply a town with tainted water or compel those living in villages to depend on wells of doubtful purity, which sometimes run dry when water is most in demand. Abundance of good water in the house convenient for use at will is a sanitary necessity, and it is the duty of the governing body to arrange for and secure a permanent supply at a reasonable expense and charge to the consumer.

When constructing waterworks, care should be taken in arranging and joining the iron street mains and conduits and every other apparatus used for distributing or conveying the water, so that they cannot be injured by frost or dirt or by the pounding of water hammer caused by sudden concussions of confined air. The joints should be well and carefully made, and if lead be used, each joint should be run full and solid at one teeming of the ladle, at least to a depth of two inches. Maiden or new pig lead should always be used for jointing. Each joint should have two circles of hemp rope driven well back and tight for the lead to wedge against. It is the hemp rope that keeps the joint tight; the lead holds it to its place, so it is necessary to have a good quality of rope. Above all else, it is necessary to make proper provision for cleaning out every part of the pipe system and to prevent waste or leakages, which not only wastes money, but damages the roadbeds and the foundations of property adjoining the line of pipes.

Water suitable for domestic use should be transparent, without smell, taste or suspended matters, totally free from any excreta or sewage deposits of any kind. Marsh or nullah water, which is loaded with vegetable débris, must be carefully avoided. Water for industrial purposes should be void of minerals, because they increase the cost of soap and scouring materials when used for cleaning purposes; they scale steam boilers and heating pipes and interfere with the production of colors when dyeing fabrics. The French cloths are always softer to the touch than British, because of the quality of water used in finishing and dyeing, and thousands of pieces of manufactured stuffs are sent over to France from England to be dyed and finished and then returned. Tainted, dirty water, with a mixture of fine sand, would ruin a stuff manufacturer or dyer in a short time. It is advantageous to secure water well aerated, similar to the water at the foot of Niagara Falls or rain water, which, during its fall through the atmosphere, secures (according to analysis made by Dr. E. A. Parks, F.R.S.) a large percentage of oxygen.

D. G. F. Gaskins, C.E., when delivering his presidential address before the British Association of Waterworks Engineers, at Nottingham, last year, stated that to manage a waterworks a knowledge was demanded which could only be obtained by close study, application and practice. This is different teaching to that of a prominent civil engineer, who wrote to me saying that there was no room in Canada for experienced waterworks superintendents, because the colleges were turning out yearly more students than there were such places to fill. If the students fill such positions raw from the colleges without learning the trade and securing working experience, whatever salary or wages they receive, it is little better than robbery of the ratepayers. A valuable engineer never attempts to construct or even manage the construction of systems that have been planned and laid out from his own ideas. He keeps his position and expects the mechanic and manager to faithfully keep theirs.

Mr. Mansergh, in his fifteen thousand dollar report on Toronto waterworks, expressed himself in a way that can only be interpreted to mean that he considered the construction and management of all American waterworks systems of a low standard. He attributed the reason to the fact that the city of Toronto had to pump over one hundred gallons of water for each inhabitant each day, to waste or misuse, adding the important remark, "as in other American cities." The reason why there is a low standard of public works in this country in comparison to the works in the old country is because there is no proper check placed on the local authorities by the government. A single ratepayer, having a substantial grievance and who can prove that the local authorities are wasting public money, or mismanaging the public business, or allowing the public works to be mismanaged, or voting themselves funds, etc., can petition the English local government board, who will send an expert engineer to make a full inquiry, and if abuse of the trust put in the representatives elected by the popular vote be proved, or it is found that any of the officials are not worthy of the confidence placed in them, he will report the same to the government, who will take measures to correct the evil.

I was appointed to investigate a waterworks on which there had been an inquiry of this kind, and I proved that most of the wealthiest manufacturers were daily stealing large amounts of water, and that less than half the amount of water provided by the ratepayers of the town was paid or accounted for. The result of the government interference in this case was a saving to the public taxes of about $30,000 each year afterward.

Mr. Griffith, C.E., states that under proper management the advantages of local authorities owning their own waterworks are as follows:

1. A local authority elected by residents in the districts has a greater personal interest in the matter of supply, and is better qualified to administer the undertaking in their own interest than a private company, whose only object is profits.

2. A local authority need not make any profit out of the supply. They can also borrow capital for construction of the works cheaper than a private firm, and reduce the charges for supply to consumers accordingly.

3. Public sentiment is always in favor of having such a universal necessary of life and health in their own hands.

The chief difficulties against public ownership are:

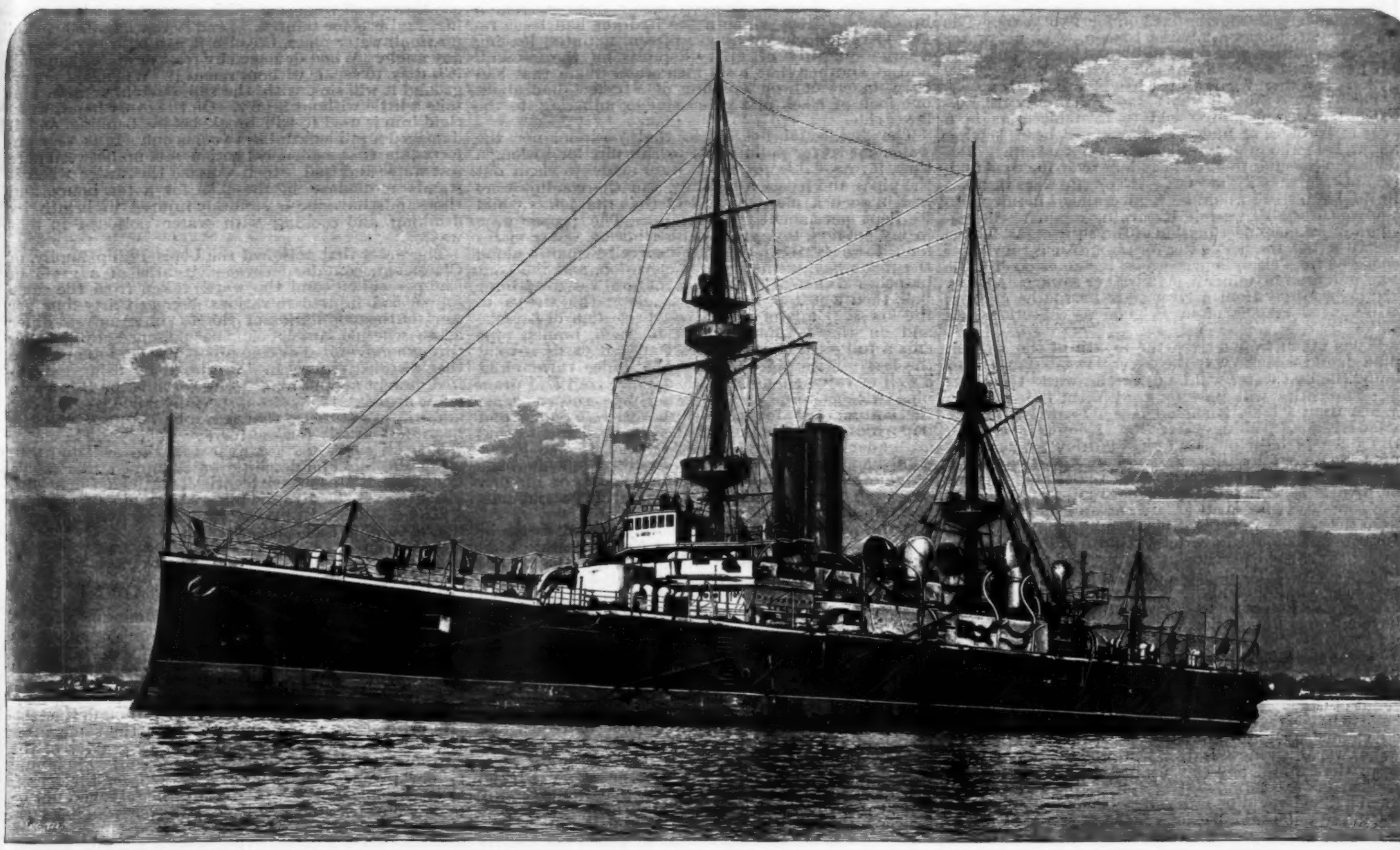
1. The periodical changes of council and sometimes even the constitution, which often interferes with the continuity of a policy.

2. The liability of the works being handled by men appointed through society, family or political influences, in place of having skilled mechanics and experts.

3. The habit, which is sometimes allowed or blindly ignored, of selling favors and accepting perquisites, which often is the cause of scamp work being done, and of public works costing more than similar works done by private business firms or such well conducted councils as Glasgow.

The revenue from the sale of water in Toronto is stated in the newspapers to be $445,000. Taking the population at the highest stated number, viz., 190,000, it runs about $2.30 per head, an average for each house of five inmates of $11.50. They say we owe on account of the waterworks $3,817,287.32, or an average per head

* Abstract of paper in Canadian Engineer.



HER MAJESTY'S FIRST-CLASS BATTLESHIP RENOWN, 12,350 TONS, CONSTRUCTED AT PEMBROKE DOCK YARD.

of $20.09. Had the Toronto waterworks been constructed and managed by a business firm, with the ability of the T. Eaton Company, for example, it would not have cost half, and the charge to consumers could have been proportionally less.

There cannot be a great difference between the need for water in European and Canadian towns which have similar conditions, only that English towns use a great percentage of their water in supplying cheap public swimming baths of large dimensions. The difference in consumption has no connection with the fact that the heat or cold is more excessive, because the returns given us of the water pumped in Toronto in the months of April and November, when there is no garden or street watering, public water fountains, no frost needing taps to be kept running, nor anything at all different to any British town, gives only a little different figures to those published for any of the other ten months.

Mr. Palmer, C.E., states that the Malvern authorities supply each water consumer with a meter, and the average consumption is 5½ gallons per head per day. I know several small towns that do not use meters which use less than 6 gallons of water for household purposes per head per day. The total quantity of water used for all purposes in the town of Nottingham, with a population of 250,843, last year was stated to be under 21⅛ gallons per head per day. In Bradford, a town of 240,000 inhabitants, they used 26 gallons per head through meter for manufacturing purposes and about 27 for all other purposes, including several large swimming baths. Mr. Bateman states that he tested a group of 14 towns in England and found the average consumption for all purposes was 24 gallons, and in a single group of working class houses containing 82 inmates the average consumption per day per head was 7½ gallons. I myself tested a house in Toronto by having a new Siemens water meter fixed on for five years. The house had 11 inmates, 2 baths, 1 basin, w. c., hot water and range boilers, hose pipe, stable and horse. The average amount of water taken each year was under 28,000 gallons, less than 7 gallons per head per day.

The Toronto Star on May 1 stated that only 198,000,000 gallons of water were sold to manufacturers in a year in Toronto, or under 3 gallons per head, leaving about 100 gallons per head per day for sanitary and domestic consumption, or 75 gallons over the consumption of similar British towns. If Toronto were situated in England, there would be a government inquiry into the cause of this waste. Returning again to the mechanical and engineering side of the subject, as I have before stated, the best water for public use is rain water collected from clean land, because it cannot possibly be contaminated by mineral, manurial or sewage deposits. Taking a supply from a river near its source or from an elevated lake is often as good as collecting rain water.

When taken from a river, the mouth of the suction pipe should face the way the water flows, because by so doing the best water will be drawn in, while the floating impurities will pass forward with the current. When from a lake, it should face downward for the same reasons. Taking water from a lower level than the town is built on is often injudicious, because it may be fouled by the sewage from the population living within the watershed, which sometimes contains an area of several thousand square miles, and should the population be small at present and the impurities from the sewage imperceptible, it may soon alter. All large towns should have forethought sufficient to arrange for a good permanent supply while the opportunity serves. To depend on a supply by pumping and long suction conduits is risky and expensive, and it is probably cheaper to carry a supply fifty miles and have a proper gravitation system:

1. Because the source of supply being necessarily at a higher elevation than a pumping source, it is less liable to be contaminated.

2. Though the first cost of works may be more on account of the long length of trunk mains, which might have to be conveyed through tunnels and across ravines on viaducts, yet the annual expenses of pumping, in wages, repairs, renewals, etc., will probably amount to more than would pay the interest on the capital expended on a comprehensive, well engineered scheme. Such a plant would be safe and permanent, besides free from contamination, because by making judicious arrangements to supply the villages located on the route of the pipe by measure, sufficient revenue might be collected to pay the interest on the cost of running the trunk pipe through their section of territory.

When it is necessary to store water in reservoirs so that the supply can be abundant when the rainfall is least, such reservoirs should be carefully covered over and ventilated. In form they should be deep rather than extended, so as to lessen the evaporation, to keep the water cool and at an even temperature so far as possible all the year round, to prevent the water from absorbing the impure gases from the atmosphere and prevent the sun's rays from increasing the microbes and bacteria. When large natural reservoirs are made in the hills, they must necessarily be open, and the face of the water exposed to the sun and air; such water should be passed through a good clean filter immediately before entering the supply pipes. In fact, all water, however collected and stored, should be filtered.

It is a fact that the purer and softer the water is, the easier it is to contaminate. It will attract and absorb minerals and poisonous gases with a wolfish appetite. At Harrogate, in England, there are eleven springs of water, each loaded with different minerals and chemicals, which each stream has taken up on its passage through the earth from the seat of the rainfall to the springs.

Then another example: Six families, living in good, airy, isolated houses, went on their holidays for a few weeks to the seaside. A short time after each family returned home some of its members were taken ill with typhoid fever. Being superintendent of the water supply, it was my duty to investigate so remarkable an occurrence, and I found that the owner had broken the laws of water distribution by allowing his tenants to take the whole of their water supply from a large shallow open cistern, hidden in the false roof, that was open from end to end over all the sleeping rooms of the six houses, and that the loft had no ventilation whatsoever; so that all the poison contained in the atmosphere of the sleeping rooms passed through the porous plastered ceiling, and having no other means of escape was absorbed by the sheet of water in the cistern, and the water became poisoned before being used by the inmates. A French writer has, indeed, proved that the human system can be trained to receive large doses of poison without serious injury. If his theory was incorrect, how could so many people live in a poisoned atmosphere, yet have general good health. The trouble with this group of families was that they had lived at another place for a time and broken the continuity of the doses, and when they returned home and began to take them up again on a healthy, well ordered constitution, the sudden start upset them. The water would be worse than usual on account of a small quantity only having been used during the time of absence. I have related this at length to show the great importance of covering fresh water tanks and reservoirs, and the advisability of erecting them in places sufficiently removed from any chance of contamination.

With the object of removing dirt from the lower points of street water mains, some engineers connect the ends of the pipes together and form a circuit of water down one street and up another. The method does not remove the evil, but distributes over a larger area the dirt or polluted water in the pipes. I believe the circulating policy is adopted in Toronto, for I am sometimes engaged to remove fish and other obstructions from taps and valves. I also notice if a bath full of fresh water stands for a few days, there is a sediment at the bottom. Then water taps and other waterworks appliances only keep in good condition about a quarter as long as at places where the water is free from fine sand and grit. The cost of repairs and renewals on account of fittings being injured by the grit must amount to a large sum throughout the whole city. I once witnessed water flowing from a branch pipe from which a fire hydrant had been removed run black for about fifteen minutes, leaving a large quantity of gritty deposits on the ground, and at another time a six inch water main that had been taken out on account of a defect had about one inch of black and green sludge adhering to the lower side.

The dirt could not lie in that position, nor the water get so far polluted as to run dirt for so long a time, if reasonable provision were made to clean out the pipes and suction conduit, and the conduit were laid in such a mechanical way that the joints could be kept permanently watertight. The proper way, in my opinion, to lay down distribution water mains for a town is to lay the large carrying mains along the roads having the highest elevation, and take out branches commencing with a cut-off valve and air ball, then continue them down along the streets to the lowest points of each street or section of streets, and on the terminating end of each branch pipe affix a full sized sluice valve about ten yards beyond the last service pipe. Round the sluice valve build a well or valve chamber with a gully trap and drain pipe twice as large as the water pipe, and construct the bottom one foot below the valve. Solids and impurities of all kinds contained in water mains that are under pressure are always forced to the lowest points, and can be easily removed by opening the terminating valves about once a month, or oftener, according to the quality of the water, for about one-half minute.

Water mains should be as carefully graded as gas or sewer pipes, and have air balls of the self-acting kind fixed at all the highest points, and full sized sluice valves at all the lowest points and dips, so that the whole system may be emptied and cleaned when necessary, and freed from deposits of grit and slime.

It must be remembered that water will run through water without moving the water adhering to the sides of the pipe it is passing through, and if the mains are larger than is needed to pass the supply taken from them, and the water is soft and pure, the motionless water clinging to the sides will set up an action with the metal and become hardened and turn into a brown calcareous matter, and continue to grow and diminish the bore of the pipe until there is just sufficient room to pass the necessary stream, when it will stop and continue in that shape for any length of time. For example, I inspected a fire hydrant intended to protect an isolated hall in a corner of a town, and found that it would not deliver any more water than the common bib water tap on the kitchen sink. On cutting the three inch main to find the cause, I found it calcarized and the bore reduced as above stated, and the whole of that branch line for about one-half mile had to be relaid with new pipes. Had the terminating sluice valve been open full wide once a month, and the dead water clinging to the sides of the pipe let out, along with any calcareous scales that might have started to form, it would never have been necessary to relay, and the hall would not have been in jeopardy for several years.

A 30 inch earthen pipe having cemented joints, that carried water from one storage reservoir to another on the moor land, got its bore diminished by fine rootlets passing through the cracks in the cement joints, growing inside and choking the interior. The calcareous matter growing on the inside of water mains can be removed by a machine called a ferret, which is so constructed that the pressure of water turned on behind it will force it through a moderate length of water pipe, and during its passage it will scrape the inside clean. When this method is used, clean out doors must be provided at short intervals.

Neither large nor small water filters are of any use except proper provision is made for cleaning them easily, because, no matter what material is used for a filtrate, there is a limit to its usefulness. The best filters are made from animal charcoal well pressed together, so that the water must pass through the coal or magnetic carbide of iron. For purifying fresh water that is void of sewage deposits, about fifteen inches of fine washed, clean, sharp sand and twenty inches of gravel will make a suitable filter, if the top layer is removed and clean washed; then spread on again about once each week. This will make the water of a bright color and pure. If I were to build a filter on a large scale I should have a graded concrete bottom, so that the water on escaping from the filtrate material would come together and form a stream to enter the distribution pipes. I would then have a false grated bottom, bearing on pillars, to hold the filtrate material. I would run the water to be treated over shallow troughs, the bottoms pierced with very fine holes, at a convenient elevation above the filter, so that all the water intended to be filtered would fall into the filter in a fine spray similar to a needle bath; falling a distance, say, of four feet, in the form of a fine spray, the water would be aerated. I would also make a good system of ventilation that would insure a strong current of air to be continually passing between the cemented and false grating floor at the bottom of the filter. The water should pass slowly through at a pressure of about two feet above the face of the sand.

When water is delivered to consumers the shut off tap, usually fixed in the sidewalk near the street line, should be of the screwdown pattern, with the valve working loose inside, so that when full open it would allow water to pass through toward the house, but it would not allow any to return back into the mains. The tap would have a double action; it would not only make a first class stop tap, but also a foot or check valve. This would prevent any fluid being forced or drawn into the street mains, and effectually prevent the return of hot and tainted water from water heating boilers, steam and range boilers, etc., which is at present very prevalent.

Lead water pipes when laid in the earth should not be near any metal, because a galvanic action will be produced; nor near an electric car line, for the electricity will damage the lead if the soil it lies in is damp and a good electric conductor. Nor should it be laid near any tile or other drain, because a leakage of water would find a downward way of escape, and could not be easily found; nor under any manure pile, or near dirt or filth of any kind, because when the water is motionless in the pipe it will absorb some of the foul gas thrown off from such filth through the lead coating, and become tainted. Lead is the handiest metal for small water pipes, because it can be easily bent to any angle. When damaged by frost or water hammer it is easy to repair without removal. When laid underground it will sink with the soil, stretch, or give and take a little without injury. On the other hand, when rigid iron is used it will break before bending, and if damaged a full length has to come out. It is very unfortunate that a chemical action sets up between pure soft water and lead, which poisons the water when it stands motionless in the pipe for a few hours, and thousands have been seriously injured in health by drinking and cooking with water poisoned in that way.

The water that poisoned the Louis Philip family, of Claremont, contained seven-sixteenths of a grain of lead per gallon, and the water taken from the same source had injured to various degrees thirty-four per cent. of the population of the town. Analysts differ as to whether water can be poisoned by passing through galvanized or zinc pipes or not. I am positive that distilled water can be injured by using galvanized vessels, and, if so, other water must be injured to a less degree. Black iron, specially made very strong and soft in nature, so that it can be bent easily, is the healthiest article for use for service pipes. Some of the means suggested for removing the evil, and still using lead pipes for domestic water supply, are: 1. To line the lead pipe one-sixteenth of an inch thick with block tin. 2. To give the pipes a bituminous coating. 3. To boil the lead pipe before using in a strong solution of sulphur and soda.

THE WORKING OF SHEET ALUMINUM.

Now that the manufacturers of aluminum have reduced the price to such an extent that aluminum used in large quantities for replacing brass can be used as economically as this latter metal, it has occasioned a great many inquiries as to what the proper methods are for working it, both rapidly and economically. Some factories have maintained that although the relative price of aluminum and brass were the same, after taking into consideration the specific gravity of the two metals, it was impossible to work aluminum as cheaply as brass could be worked, for the reason that the machinery working the metal could not be operated as fast, etc. Anyone, however, who has gone carefully into this subject will find that this is not so, and that when it comes to performing machine work of any kind on the sheet metal, it can be done in all cases as cheaply as brass, German silver, or tin plate can be worked, and in some instances it can be worked cheaper.

It has often been said, and correctly so, that the alloys of aluminum compare with the pure metal about as brass compares with copper. No better illustration could be given than this, and so accustomed have many of the shops in this country become to working brass that they would find it difficult to work copper, but the majority of cases in aluminum are just the reverse; that is, the people who find fault in regard to the cost of working aluminum have in the majority of instances based their opinion on the cost of working the pure metal. And so it is in the manufacture of most of the fancy articles out of aluminum; it is no more advisable to use the pure aluminum than it would be to make a similar article ordinarily made of brass out of the pure copper. This fact is not fully appreciated, especially by the people using aluminum, because their first experience has been with the pure metal, and it is difficult to get them to make a change.

The great secret, if there is any, in working aluminum, either pure or alloyed, consists in the proper lubricant and the shape of the tool. Another great disadvantage in the proper working of the metal is that, when a manufacturer desires to make up an article, he will procure the pure metal in order to make his samples which, of course, is harder to work than the alloy. But the different grades of aluminum sheet which are on the market are so numerous for different classes of work that it might be advisable to consider them for a moment before passing to the method of working them.

The pure metal, to begin with, can be purchased of all degrees of hardness, from the annealed, or what is known as the "dead soft" stock, to the pure aluminum hard rolled. Then comes a harder grade of alloys, running from "dead soft" metal, which will draw up hard, to the same metal hard rolled; and still again, another set of alloys which, perhaps, are a little harder still when hard rolled, and will, when starting with the "dead soft," spin up into a utensil which, when fin-

ished, will probably be as stiff as brass. These latter alloys are finding a large sale for replacing brass used in all classes of manufactured articles.

To start with lathe work on aluminum, probably more difficulty has been found here, especially in working pure metal, and more complaints are heard from this source than from any other. As stated before, however, these difficulties can all be readily overcome if the proper tools and the proper lubricants are used, as automatic screw machines are now made so that they can be operated when working aluminum just as readily as when they are working brass, and in some cases more readily. To start with the question of the tool, this should be made as what is known as a "shearing tool," that is, instead of a short, stubby point, such as would be used in turning brass, the point should be lengthened out and a lot of clearance provided on the inside of the tool, so as to give the chips of the metal a good chance to free themselves and not cause a clogging around the point of the tool. A similar tool, for instance, as would be used for turning wood.

The best lubricant to be used would be coal oil or water, and plenty of it. The latter is almost as good as coal oil if enough of it is used, and with either of these lubricants and a tool properly made, there should be no difficulty whatsoever in the rapid working of aluminum, either on the lathe or on automatic screw machines.

To go from the lathe to the drawing press, the same tools here would be used in drawing up shapes of aluminum as are used for drawing up brass or other metals. The only precaution necessary in this instance being to use a proper lubricant, which in this case is a cheap grade of vaseline, or in some cases lard oil, but in the majority of instances better results will be derived by the use of vaseline. Aluminum is probably susceptible of deeper drawing with less occasion to anneal than any of the other commercial metals. It requires but one-third or one-fourth of as much annealing as brass or copper. When, for instance, an article which is now manufactured in brass, requiring say three or four operations before the article is finished, it would probably have to be annealed after every operation. With aluminum, however, if the proper grade is used, it is generally possible to perform these three operations without annealing the metal at all, and at the same time to produce a finished article which to all intents and purposes is as stiff as an article made of sheet brass.

Too much stress cannot be laid on the fact of starting with the proper grade of metal, for either through ignorance or by not observing this point is the foundation of the majority of the complaints that aluminum "has been tried and found wanting." If, however, it should be found necessary to anneal aluminum, this can be readily accomplished by heating it in an ordinary muffle, being careful that the temperature shall not be too high—about 650° or 700° F. The best test as to when the metal has reached the proper temperature is to take a soft pine stick and draw it across the metal. If it chars the stick and leaves a black mark on the metal, it is sufficiently annealed and is in a proper condition to proceed with further operation.

Next taking up the question of spinning aluminum, again success depends particularly on starting with the proper metal. The most satisfactory speed for articles from five inches to eight inches in diameter is about 2,600 revolutions a minute, and for larger or smaller diameters the speed should be so regulated as to give the same velocity at the circumference. Aluminum is a very easy metal to spin and no difficulty should be found at all in spinning the proper grades of sheet. Several factories that are using large quantities of aluminum now, both for spinning and stamping, are paying their men by the piece the same amount as they formerly paid on brass and tin work, and it is stated that the men working on this basis make anywhere from 10 per cent. to 20 per cent. more wages by working aluminum.

After aluminum has been manufactured into the shape of an article the next process is the finishing of it. The best polish can be obtained by first cutting down the metal with an ordinary rag buff on which use tripoli, and then finish it with a dry red rouge which comes in the lump form, or that which is known as "White Diamond Rouge." One point, however, that it is necessary to carefully observe is that both the tripoli and the rouge should be procured ground as fine as it is possible to grind them; for, if this is not done, the metal will have little fine scratches all over it, and will not appear as bright and as handsome as it otherwise would.

If it is desired to put on a frosted appearance, this can either be done by scratch brushing or sand blasting. A brass wire scratch brush, made of crimped wire of No. 32 to No. 36 B. & S. gage, with three or four rows of bristles, will probably give the best results. This work of scratch brushing can be somewhat lessened, however, if, before applying the scratch brush to the surface of the aluminum, the article is first cut down by the use of a porpoise hide wheel and fine Connecticut sand, placing the sand between the surface of the aluminum and the wheel, so that the skin and the irregularities on the surface are removed, and then putting the article on a buffing wheel before attempting to scratch brush it. This method, however, is probably more advantageous in the treating of aluminum castings than for articles manufactured out of the sheet metal, as in the majority of cases it is simply necessary before scratch brushing to cut down the article with tripoli, and then polish it with rouge as already described, before putting on the scratch brush; in this way the brush seems to take hold quicker and better, and to produce a more uniform polish.

An effect similar to the scratch brush finish can be got by sand blasting, and by first sand blasting and then scratch brushing the sheets, a good finish is obtained with very much less labor than by scratch brushing alone. Another very pretty frosted effect is procured by first sand blasting and then treated as hereinafter described by "dipping" and "frosting," and many variations in the finish of aluminum can be got by varying the treatment, either by cutting down with tripoli and polishing, scratch brushing, sand blasting, dipping and frosting and by combinations of those treatments. A very pretty mottled effect is secured on aluminum by first polishing and then scratch brushing and then holding the aluminum against a soft pine wheel, run at a high rate of speed on a lathe, and by careful manipulation quite regular forms of a mottled appearance can be obtained.

The dipping and frosting of aluminum sheet is probably the cheapest way of producing a nice finish. First remove all grease and dirt from the article by dipping in benzine, then dip into water in order that the benzine that adheres to the article may be removed, so as not to affect the strength of the solution into which it is next dipped. After they have been taken out of the water and well shaken, the articles should be dipped in a strong solution of caustic soda or caustic potash, and left there a sufficient length of time until the aluminum starts to turn black. Then they should be removed, dipped in water again, and then into a solution of concentrated nitric and sulphuric acid, composed of twenty-four parts of nitric acid to one part of sulphuric acid. After being removed, the article should be washed thoroughly in water and dried in hot sawdust in the usual way. This finish can also be varied somewhat by making the solution of caustic soda of varying degrees of strength, or by adding a small amount of common salt to the solution.

In burnishing the metal use a bloodstone or a steel burnisher. In burnishing use a mixture of melted vaseline and coal oil, or a solution composed of two tablespoonfuls of ground borax dissolved in about a quart of hot water, with a few drops of ammonia added. In engraving, which adds materially to the appearance of finished castings, book covers, picture frames and similar articles made of sheet, probably the best lubricant to use on an engraver's tool in order to obtain a clean cut, which is bright, is naphtha or coal oil, or a mixture of coal oil and vaseline. The naphtha, however, is preferred, owing to the fact that it does not destroy the satin finish in the neighborhood of the cut, as the other lubricants are very apt to do. There is, however, as much skill required in using and making a tool in order to give a bright, clean cut as there is in the choice of the lubricant to be used. The tool should be made somewhat on the same plan as the lathe tools already outlined. That is, they should be brought to a sharp point and be "cut back" rather far, so as to give plenty of clearance.

There has been one class of work in aluminum that has been developed lately and only to a certain extent, in which there are great possibilities, and that is in drop forging the metal. Recently some very superior bicycle parts have been manufactured by drop forging. This can be accomplished probably more readily with aluminum than with other metals, for the reason that it is not necessary with all the alloys to work them hot; consequently they can be worked and handled more rapidly.—The Aluminum World.

THE MANUFACTURE OF RUBBER SUBSTITUTES.

SUBSTITUTES enter very largely into the compounding of rubber, because of certain distinct advantages which they possess and which are not shared by coal tar or the simple mineral adulterants. They have not the vulcanizing effect of sulphur or the metallic oxides and sulphides. Their chief value lies in cheapening the stock without disturbing its working qualities or impairing the texture, finish or weight of the manufactured product. Their after effect on the life of the goods is, however, another matter.

The term rubber substitute may be broadly considered as including any substance possessing characteristics similar to those of unvulcanized rubber and adapted to displace it in compounding. Ordinary reclaimed rubber, as well as the sulphurized oils, are included in this definition.

The reclaimed rubber of commerce is obtained by steaming or devulcanizing old rubber waste, generally shoes, freed more or less perfectly from fiber. Having originally contained some real caoutchouc, it is generally considered rubber of low grade rather than rubber substitute. Since its introduction its use has rapidly extended, until it is now a very essential factor in the ordinary and cheap lines of goods and its presence is not entirely unknown even in the highest grades. As a substitute it ranks first in merit and general use; the annual output in this country alone reaching thousands of tons.

As a substitute it is most available in goods where color or extreme lightness are not essentials. Being chemically inert, that is, free from any oxidizing tendency, it can be compounded with rubber in all proportions without injury to the new stock.

The sulphurized oil substitutes constitute a class by themselves and are distinguished as brown or white, although chemically they are essentially very similar. Any of the readily oxidizable, rejectable or drying oils combine freely, under proper conditions, with sulphur to form a more or less rubberlike mass. According to the selection of the oil and the mode of treatment, we get brown or white substitute. Such oils as linseed, rape, mustard and peanut are well adapted to make brown substitute. The process is a simple one, consisting in boiling any one of these oils or mixture of them in any proportion with flowers of sulphur. The operation may be carried on over a fire or by steam in a jacketed kettle. The proportions are generally about eighty per cent. of oil and twenty per cent. of sulphur. The reaction is complete in three or four hours at the heat of steam at a pressure of eighty pounds (325° F.)

It is well to boil the oil out of doors or in a strong draught of air to carry off the noxious vapors. The mixture should be thoroughly stirred while cooking.

Mustard oil reacts quite promptly with sulphur, but gives a firmer product and one that breaks rather shorter than that from the other oils named. It is best used in mixture with them. Linseed gives off the most disagreeable odor and has no special advantage in point of quality of product.

The white variety of oil substitute is made by treating refined mustard, rape, castor or cocoanut oils separately or in mixture with sulphur chloride either in the cold or with moderate heat.

The light, porous variety may be made by mixing with the oil a small proportion of sodium bicarbonate, which, under the influence of the sulphur chloride, generates gas in sufficient quantity to render the whole mass very spongy.

The operation should take place in an earthen or lead lined vessel and the sulphur chloride added slowly and stirred briskly into the oil.

The proportion of sulphur chloride to oil should be about one to eight, and of soda to oil about one to twelve.

When the chemical action is over, the product is allowed to dry for a couple of days before use.

A solid amber colored substitute is made in the same way and proportions, omitting the sodium bicarbonate.

All operations involving the use of sulphur chloride should be conducted in a strong draught and best in the open air, to avoid the evil effects of the vapors.

Chemically the use of these sulphurized drying oils in rubber compounds is bad. They exert a marked influence in shortening the life of the goods, because, by their active chemical nature, they hasten the oxidation of the rubber present to the brittle resinous products which give evidence of their existence in the compound by its loss of elasticity and by the hardening and cracking of the surface. There is little to be said for these oil substitutes from a chemical point of view. Their great practical value is entirely a matter of price, for they enable the manufacturer to cheapen the stock while maintaining the proper relative weight or specific gravity of the compound with reference to pure rubber.

The matter of specific gravity, or the ratio of the weight of any substance to that of an equal volume of some other substance taken as a standard, is a point of much importance. It governs the relation of pound price and piece price in rubber manufacture.

Specific gravity and the percentage of ash in a rubber compound once gave an indication of the amount of rubber present, but, since the extensive use of oil substitutes, they have no value as specifications of quality.

The specific gravity of caoutchouc or pure unvulcanized rubber is 0·915. It will therefore float in water about like ice, that is, nearly submerged. The oil substitutes are slightly heavier; enough so to sink in water.—India Rubber World.

ACETYLENE ON BOARD SHIPS.

ACCORDING to the Gas World, "Acetylene Gas and Its Probable Future Afloat" was the title of a lecture that Prof. Vivian B. Lewes delivered before the Institution of Naval Architects, on Thursday, April 8. Having briefly described the discovery and properties of commercial calcic carbide and acetylene, Prof. Lewes proceeded to discuss methods by which the latter might be applied on board ship. He said that the possibility of liquefying acetylene at pressures about those at which liquid carbon dioxide was produced so largely enabled considerable volumes of the gas to be compressed in the liquid state in small wrought iron or steel cylinders, and that it was in this liquefied condition that the gas would have to be utilized on board ship. At the freezing point, liquid acetylene would give about 370 times its own volume of gas. The pressure which liquid acetylene exerted upon the cylinders containing it varied with the temperature, but for all ordinary degrees of heat—say, from 60° to 75° F. —the pressure would be from 600 to 700 lb. on the square inch, while when heated to 98° F. the pressure rose to 1,020 lb. The cylinders, however, were generally tested to two or three times this pressure, so that there was an ample margin of safety.

During the past two years there had been two or three explosions caused by cylinders of liquefied acetylene, and these had given rise to a feeling that acetylene in this form was not safe; but it must be remembered that the introduction of a compound of this description, with comparatively unknown properties, must for a considerable period be hampered by accidents caused by improper usage; and there was proof that in each of the accidents that had occurred the screw plugs closing the cylinders were being tightened up with undue violence.

The Factor of Danger.—The factor of danger in liquid acetylene, and also in the compressed gas, was that acetylene was an endothermic compound, i. e., a compound in the formation of which heat is absorbed, instead of, as is usually the case, being liberated; and with such compounds this heat was again set free when they underwent decomposition, and added considerably to the violence of the action. At any pressure up to two atmospheres acetylene was perfectly safe from any explosive action per se, as at these low pressures high temperature, or even the detonation of a charge of mercuric fulminate in the gas, only caused local decomposition, and the explosion did not travel for more than a few inches from the spot where it was started; but directly the gas was put under more than two atmospheres pressure a red heat would initiate explosion through the whole volume, this being due to the sudden resolution of the acetylene into its constituent elements, carbon and hydrogen, with the liberation of the endothermic heat stored up in it. This all sounded very alarming, but when the conditions of danger were realized it was at once evident that, with rational treatment, cylinders of liquid acetylene were for all practical purposes perfectly safe, as, when kept in water tanks, nothing short of the surroundings being on fire would give the requisite temperature to cause danger, and on board a vessel the cylinders could easily be dropped overboard on a line until such danger had passed.

For Buoys and Lighthouses.—When it was considered that a cylinder holding 1 cubic foot of the liquefied gas would supply a burner giving a light of 32 candles for 400 hours, it was evident that there were great possibilities for it in the future on ships and yachts not fitted with the electric light. With a proper and special arrangement, highly efficient gas engines could be driven by it, and in small atmospheric burners it gave a flame of very high temperature; so that it was by no means impossible that the twentieth century might see a high speed torpedo boat driven by an acetylene engine, with an acetylene search light and an acetylene cooking stove, while some might even add to the equipment an acetylene torpedo, as a most effective "Sprengel" explosive might be made from liquid acetylene and chlorate of potash. These were dreams of the future, but there were certain spheres of utility ready for acetylene in which no plea of danger could be urged against its adoption. The first of these were floating buoys. At the present time there were four methods by which these could be lighted: 1. Electricity. 2. Compressed oil gas. 3. Com-

pressed coal gas enriched by gasoline. 4. Wigham's oil lamps. With electricity, the chance of the conducting wires being fouled by an anchor or dredge always existed; the compressed oil gas needed a small gas works and compressing plant; compressed coal gas and gasoline enrichment demanded the latter if not the former; while Mr. Wigham's oil lamps stood out as being both good and economical. There was room, however, for acetylene for this purpose, and a cylinder of liquid acetylene having a capacity of 1·75 cubit feet, fitted with a reducing valve, and stored in the bottom of the buoy, would give a clear white light of 32 candles for one month, and in cost would even now be about equal to compressed oil gas giving the same amount of light. If legal restrictions should prevent liquid acetylene becoming a commercial commodity, then compressed acetylene gas in cylinders, of the Pintsch or Pope pattern, could be effectively used, the gas giving a candle power three times as high as the best freshly pumped oil gas. For such purposes as buoy lighting and for use in lightships, the cylinders of liquefied acetylene seemed to be especially adapted, while the still more important function of an auxiliary light for use in lighthouses would be best carried out with the uncompressed gas. For lighthouse use the apparatus would be so rapid in action that, even with the holder empty, gas could be made and the lantern burning within a very few minutes of the breakdown of the electric apparatus.

Penetrative Power.—Prof. Lewes next spoke of the penetrative power of different lights, remarking that the usefulness of a light for signaling purposes depended upon its power of passing through the atmosphere without change or absorption. Measuring the penetrative powers of different lights by means of a cell containing an artificial haze, he obtained the following data, the figures being the percentage of light lost in passing the cell:

Coal gas	11·1
Oil gas	11·5
Acetylene	14·7
Incandescent gas (Welsbach)	20·8
Electric arc	26·2

Of course, these figures merely give the loss of light in passing through the thickness (3 in.) of fog solution employed; but it was evident that they would also give approximately the ratio of the penetrative power of these illuminants in mist-laden air.

Automatic Lights.—A minor, but, at the same time, very important, use to which calcic carbide could be put was in the manufacture of signal lights of the same character as the Holmes lights now in use. He had come across several specimens of carbide of Continental manufacture which gave acetylene spontaneously inflammable in air. On investigating this phenomenon he found that it was due to the carbide containing a certain proportion of calcic phosphide, which, on contact with water, gave enough spontaneously inflammable phosphureted hydrogen to ignite the acetylene. It naturally occurred to him that this might be utilized in making very valuable signal lights, of the same character as Holmes lights, for indicating the position of life belts, torpedoes, etc., as if the Holmes cartridge were filled with a mixture of calcic carbide and phosphide, only a small proportion of the phosphide served to make the acetylene, rapidly evolved on contact with water, ignite on coming in contact with air, and the light-giving power of the flame was far more effective than that emitted by the phosphide alone. Moreover, the cartridge could be made in the form of a hollow tube, so weighted as to float with its open end downward; and if a small cage of the mixed carbide and phosphide were fixed in the upper portion, and a tube with a small burner let into the top of the cartridge, the gas escaping spontaneously lighted, and burned with a flat flame of such intensity that it could be seen for a very great distance. He should imagine that if such a candle were attached to the life buoys, flung overboard at night, it would not only guide a swimmer to the buoy, but also mark the direction in which the ship's boats had afterward to proceed.

THE MECHANICAL SHIPMENT OF COAL.

The continual increase in the production of coal mines, along with the extension given to carriage by water, has led to an improvement of the methods usually employed for the shipment of the coal. Mechanical processes are the only ones that permit of rendering this operation both rapid and economical. For this reason, numerous solutions of the question have been proposed, and the systems employed at the mines almost always vary from one exploitation to another.

The most frequent process consists in the use of cars whose boxes are jointed upon their frame and are capable of tilting to one side. This is a very simple solution, but it requires a motive power and an installation of special lifting apparatus.

At the mines of Lens cranes are installed upon the locomotives, while in other exploitations the tilting motion is effected through a compressed air apparatus somewhat similar to the brake apparatus in use upon railway lines and which the engineman can maneuver from the locomotive.

The idea has occurred to do away with the use of these lifting apparatus by adopting cars similar to those used for carrying filling material upon the Panama Canal. The box of these cars was likewise jointed to the frame, but its center of gravity projected with respect to its suspension point. A bolt held the box in its ordinary position, and as soon as it was drawn, the tilting motion took place under the action of gravity.

The saving that this arrangement seems to afford is illusory, since, although it does away with the use of lifting apparatus, it thereby necessitates an increase in the dead weight of the cars in order to have a frame that shall remain in perfect equilibrium upon the rails at the moment that the box of the car is tilted. Consequently, the cost of hauling the cars from the mine to the shore is largely increased.

Besides, this system presents another inconvenience, and that is that the tilting motion is not uniform, but, on the contrary, gives rise to an inevitable acceleration, with the result that the load is dumped quite abruptly, the coal is broken in small pieces, and the proportion of waste is increased.

An endeavor has also been made to effect the shipment by means of a sort of seesaw, that is, of a board pivoting upon an axis and giving the cars a sufficient inclination to allow the coal to slide into a loading hopper. These apparatus, which were hydraulic, and consequently necessitated a special motive power, were in favor for a long time. We believe it of interest, from this view point, to make known the arrangement devised by M. Malissard-Taza, superintendent of Madam such motion. As soon as the engineman opens the cock by means of the system of levers, L, he allows the water contained in the upper part of the cylinder to escape. This flow may, moreover, be easily regulated by a maneuver of the cock so as to render the tilting motion as slow as may be desired. The action of the counterpoises, which was null at first, keeps on increasing in measure as the inclination becomes greater. This pendulum therefore serves as a moderator.

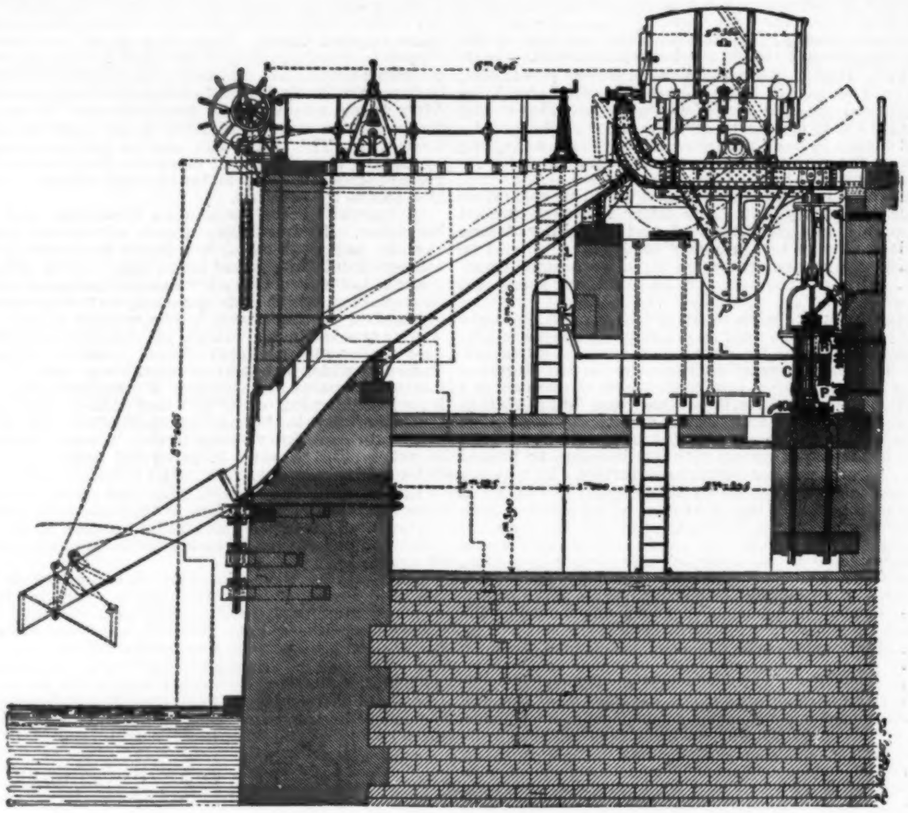


Fig. 1.—DIAGRAM OF THE MALISSARD-TAZA INSTALLATION FOR THE SHIPMENT OF COAL.

Taza-Villain's works at Anzin, since it permits of dispensing with the use of an external motive power, the apparatus operating simply under the action of the weight of the car to be discharged. This very ingenious arrangement consists of a metallic platform, F, oscillating around two journals, and upon which the car to be dumped is so placed that its center of gravity shall be eccentric with respect to the journals. A piston, P, working in a cylinder, C, completely filled with water, is connected with the platform by its rod and a jointed connecting rod, B, whose extremity is fixed on the opposite side at the center of gravity of the car with respect to the axis of the journals.

The upper and lower parts of the cylinder communicate through a conduit of small diameter provided

The doors of the car are movable around a horizontal axis situated at the highest part of the box, and, as soon as the latter begins to incline, they tend to open through their own weight and the thrust of the load; but they are kept closed by a bolt that is not withdrawn until the platform has reached the maximum inclination of 38°. At this moment the coal slides gently into the hopper. The return of the empty car to its horizontal position is determined by the action of the pendulum, and this motion is regulated likewise by the hydraulic brake.

The hopper into which the coal falls is in two parts, one of them fixed and the other movable. The former has quite a feeble inclination that renders the sliding of the coal easy and free from shock, and the other

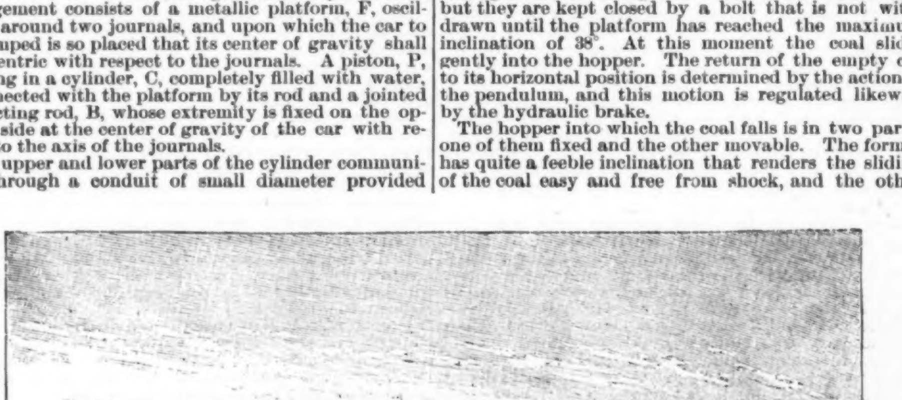


Fig. 2.—MECHANICAL SHIPMENT OF COAL.

with a cock, R. Beneath the platform, a pendulum composed of two counterpoises is so suspended that its center of gravity shall be in the same vertical plane as the axes of the journals.

After the car has been placed upon the platform it is held firmly at its two extremities and then tends to cause the platform to tilt; but, since the cock, R, is closed, the piston, in consequence of the incompressibility of the water contained in the cylinder, prevents

part can be easily maneuvered, and permits of distributing the coal in all portions of the boat.

This installation is completed by an apparatus for towing by manual power. This consists of a windlass around which winds an endless steel cable. Upon connecting this cable with the boat, it is possible to move the latter in two directions by maneuvering the windlass.

This apparatus, which is constructed for 10 ton cars,

permits of the shipment of from 20 to 25 car loads an hour, that is to say, of from 2,000 to 2,500 tons of coal per day of ten hours. It requires but two men for the operation.—La Nature.

ENDOSCOPY.

During the few months following the discovery of the X rays it was necessary to use a photographic plate in order to obtain the image of an object invisible to the naked eye. Since then, Edison, Salvioni and many others have substituted for the sensitized plate a fluorescent screen that permits the human eye to see the interior of the body as easily as if the corporeal envelope were as transparent as glass.

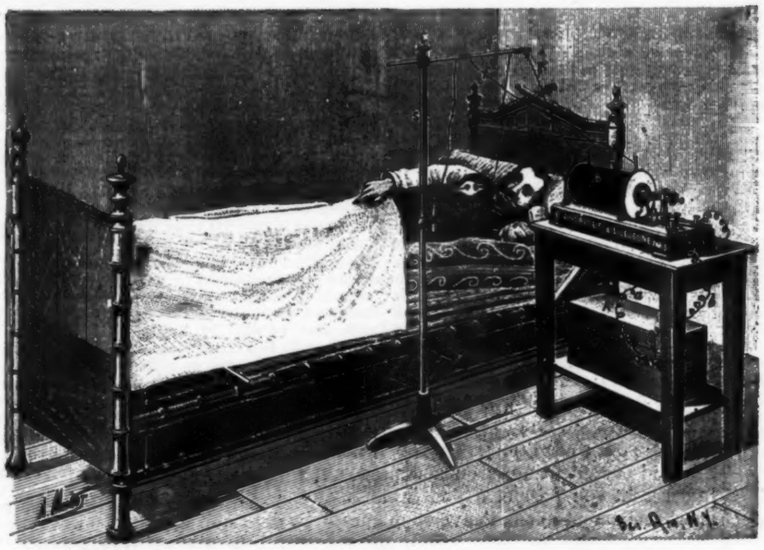


Fig. 1.—DUCRETET & LEJEUNE'S ARRANGEMENT FOR THE TREATMENT OF TUBERCULOSIS BY X RAYS.

In Italy, along about 1600, a peasant having calcined a stone, perceived that it emitted a light in darkness after it had been exposed to sunlight for some time.

This was, as now known, sulphate of baryta, which had been converted into sulphide of barium by calcination. Chemistry afterward found other bodies that are possessed of these curious properties, such as sulphide of zinc, platinocyanide of potassium, tungstate of calcium, etc. All these bodies possess, to a different degree, the singular property of emitting luminous radiations in darkness without their temperature differing from that of the surrounding medium. The ultra-violet radiations of light produce a marked action upon phosphorescence. The X rays possess the same property to a high degree.

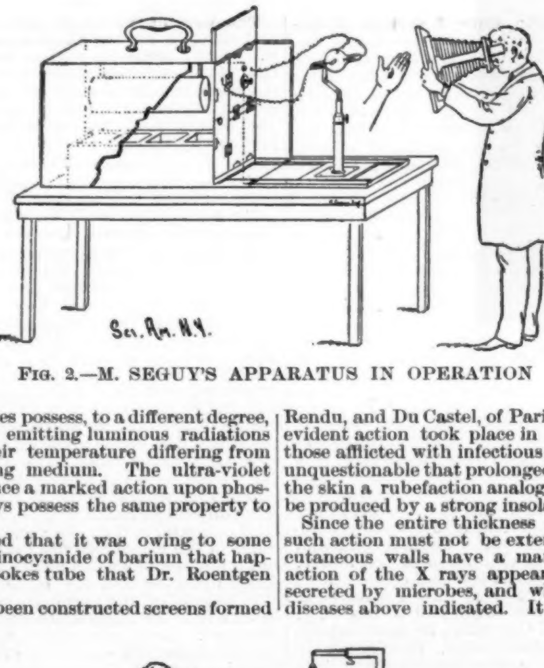


Fig. 2.—M. SEGUY'S APPARATUS IN OPERATION

Now, it will be recalled that it was owing to some paper covered with platinocyanide of barium that happened to lie near a Crookes tube that Dr. Roentgen discovered the X rays.

There have therefore been constructed screens formed of a wooden frame upon which is stretched strong paper covered with a chemical substance capable of becoming fluorescent under the action of the X rays. Upon interposing between this screen and the tube that produces the rays an object opaque to the eye, it becomes immediately visible upon the prepared surface. Thus, for example, if one puts his hand between the two objects, it at once disappears and nothing but the bony skeleton is perceived.

The consequences and advantages of this valuable observation will be at once seen. A patient may be "visited," without any trouble or suffering on his part.

It is now possible, by employing electric currents of varying strength, according to circumstances, to witness the beating of the heart, the inflation of the lungs, and the motions of the diaphragm, and to perceive the liver, the spleen and the different glands. As for the bony framework, that has no longer any secrets. The apophyses and the articulations stand out with wonderful distinctness and the slightest osseous traumatisms are revealed much better than with percussion and auscultation.

Certain affections of the bladder and aorta are discovered by means of this new method of investigation. Finally, the lesions of the lungs in consumptives are likewise observable, and this terrible disease will, perhaps, be cured by the action of the X rays. Numerous observations have already been made by Profs. Lortet and Genoux, of Lyons, and by Drs. Vilain, Rendu, and Du Castel, of Paris. It really seems as if an evident action took place in tuberculous subjects and those afflicted with infectious diseases. Moreover, it is unquestionable that prolonged radiations produce upon the skin a rubefaction analogous to that which would be produced by a strong insolation or a sinapism.

Since the entire thickness of the body is traversed, such action must not be external merely, and the subcutaneous walls have a marked sensitiveness. The action of the X rays appears to destroy the toxines secreted by microbes, and which are the cause of the diseases above indicated. It is so certain that therapeutics will make use of this method that special apparatus are already constructing, such as those represented in Figs. 1, 2 and 3. The first figure shows the arrangements made by Messrs. Ducretet and Lejeune, for the treatment of affections of the chest. The other apparatus, which were devised by Engineer Seguy, are designed to facilitate all radiographic operations (taking of photographs) or radioscopic ones (vision with a fluorescent screen). Fig. 3 shows a patient lying upon a special operating table. The center of this table is hollowed out, and, through grooves, permits of sliding in negative frames containing sensitized photographic plates designed to remain as a witness in discussed and difficult cases. In more general cases, the diseased member is examined with a sort of opera glass, which contains the fluorescent screen. This glass permits of observing in broad daylight. It forms part of a very simple apparatus inclosed in a box containing the accumulators, the Crookes' tube and the transformer (Fig. 2).

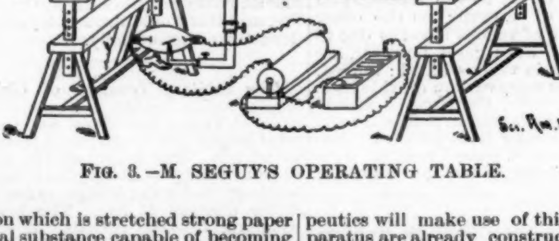


Fig. 3.—M. SEGUY'S OPERATING TABLE.

It happens, and more frequently than might be thought (as clinics can prove), that certain bodies enter the organism in an accidental way—coins into the œsophagus, pins and needles into the hand or foot, projectiles from firearms into the body, etc.

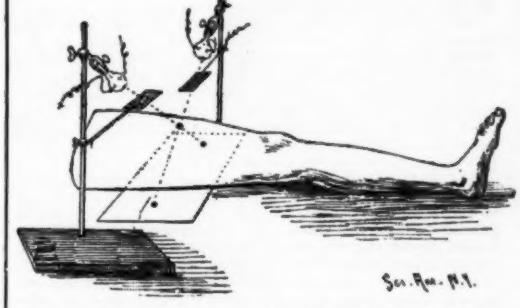


Fig. 4.—BRUNEL'S ARRANGEMENT FOR LOCATING FOREIGN BODIES IN THE HUMAN ORGANISM.

Formerly, the exploration in order to locate such bodies was a lengthy and painful operation. Thanks to the X rays, and to the following arrangement devised by the writer of this article, the place of the object is at once indicated without any suffering on the part of the patient. Say, for example, that a revolver ball has entered the thigh. The wounded member is arranged as shown in Fig. 4. Two Crookes tubes are placed above small glass or metal diaphragms and a photographic plate is placed beneath the member. Upon the plate we shall therefore have a projection of the ball at two different places. The shadows will be projected at AB' and A'B (Fig. 5). We shall have the images at BB'.

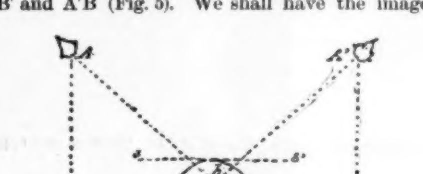


Fig. 5.—GRAPHIC DETERMINATION OF THE POSITION OF A FOREIGN BODY.

It will only remain to measure the distance of the tubes, AA', and to transfer such measurement (all proportions being kept) to a sheet of paper, as shown in the diagram. The height, h h', of the triangle BhB', measured from h to h', will give the exact situation of the foreign body, c, in the part, O, or its distance to the tangent line, s s'.

It may happen, also, that it is desired to radiograph a definite portion of an organ and that it is difficult to know the exact time that it will require to take the part desired. By means of my "doseur" all tentative efforts are avoided. This apparatus is very simple. It consists of a metal plate provided with five apertures, A B C D E, four of which may be closed by means of a shutter of the same metal.

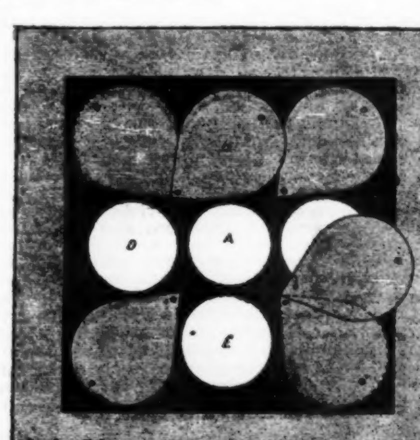


Fig. 6.—THE BRUNEL DOSEUR.

The plate may be surrounded with a wooden frame. When it is desired to obtain an image of a certain organ, a radiographic operation is first performed. The doseur is arranged beneath the Crookes tube in opening all the apertures, and an exposure is made for a fraction of a determinate time. One shutter is then closed and another exposure is made for the same length of time,

and one continues thus until the four apertures are closed. When the operation is finished, the part, A, will therefore have made an exposure five times longer than the first aperture, and the others in proportion. The plate having been developed, we shall have five very distinct circumferences upon the negatives. We shall then see, according to the part most conspicuous, the exact time that must be taken to obtain an image of the organ designated. This preliminary operation will not prove a loss of time, since otherwise we should be obliged to take three or four negatives before obtaining a good result. All those who have experimented with X rays up to the present know this well.

Among all the operations that have been performed by means of the X rays, I shall mention but one, and that an extremely interesting one. A patient who was diabetic to the last degree, and who dreaded the smallest surgical operation that might bring on a flow of blood, had a piece of a needle in his foot that prevented him from walking, and of which it was necessary to rid him through the extirpation of the metal.

Dr. Niquet and M. Radignet tried the following operation. They located the exact position of the needle by means of radioscopy, and then endeavored to attract it by means of a powerful electromagnet. In two operations of one hour they succeeded in extracting the piece of metal without drawing a drop of blood.

At present, astonishing operations that no one would have dared to attempt a few months ago are daily performed in clinics by means of the X rays.

But although X rays are used, the nature of them is not as yet known. Are they cathodic rays formed in the interior of the tubes and a portion of which alone passes through the glass? Is it the glass rendered fluorescent under the action of these rays that emits the X rays? Finally, is it a peculiar electric phenomenon?

These are the questions that confront those scientists who are occupying themselves with this obscure subject.

However, every day introduces a new element into the observations. Thus, M. Radiguet has observed in his laboratory an order of phenomena that are mysterious and confusing to the uninitiated when they pass into the darkness. The tube that produces the radiations being well wrapped in black cloth, and the darkness being absolute in the laboratory, all the crystals, glasses, gas globes and electric light bulbs are seen to become gradually illuminated. This seems like magic. If we take a glass provided with facets, the effect is wonderful. If the glass be moved about, the arm and hand being invisible, it will seem as if the glass is moving of itself without being held, and the same is the case with all glassware. It is weird and mysterious. Porcelain, enamels and brilliants also have the property of becoming illuminated under the action of the X rays. The luminous phenomenon becomes less marked at a distance, and this is perhaps the reason why it had never been observed up to the present.

What is the cause of this luminosity? It may be said that under the action of the X rays the molecules of the glass change state and emit ultra-violet rays. Now, aside from sulphate of soda, glass contains at least a certain quantity of silicate of baryta. May it not be this substance, incorporated with the glass and converted by heat into sulphide of barium, that emits the fluorescence? However this may be, M. Radiguet's observation is interesting in more than one respect. It offers a new road to researches and to practical applications that were immediately seen by its author; for example, the re-enforcement of photographic action upon sensitized plates and the construction of opera glasses and eye glasses that emit no light and that constitute X ray glasses, which are very useful to operators.

Although, then, the mystery that hovers over the identity of the X rays still exists, the numerous and beneficial applications that are made of them are capable of consoling scientists and inve-tigators for not having made a step in the way of solving this new problem in physics laid before them by the celebrated professor of Wurzburg.—G. Brunel, in La Revue des Revues.

Fig. 7.—Phenomena of Luminescent Crystals Discovered by M. Radiguet.

On May 30, the Swiss sections Tug-Golden and Luzern-Immersee on the Berlin-Milan line were opened. The result is a shortening of the journey by one hour and the leading of the line through more picturesque surroundings.—Uhland's Wochenschrift.

THE COLOR OF BLOOD.*

By Felix Oswald, B.A. Lond.

"Blood red" is so familiar an adjective of color as to readily convey the impression that the blood of all animals is red. Such, however, is far from being the case, for although the possession of red blood is a characteristic common to all vertebrates,† yet when we come to examine the invertebrates, which are far more numerous both in species and individuals, we find that blood of a red color is a relatively rare occurrence. In the majority of cases it is colorless; but it may be even green, blue or yellow.

It has often been a subject for speculation why the life fluid of higher animals should have so vivid a hue, seeing that it is normally concealed from view, and seldom or never plays any part in determining the surface coloration, excepting in a blush. It is only a partial explanation to say that the redness is due to hæmoglobin, and that it is an inherent physical characteristic of this body. The reason for the red color is quite as difficult to explain as to account for the distinguishing colors of gold, silver or copper. It is no exaggeration to say that hæmoglobin is the most important substance in the complex combination called blood, for it is hæmoglobin which absorbs oxygen from air or aerated water, conveying it to all tissues in need of that vital gas, receiving carbon dioxide in return, and finally giving up the excess of this waste product of combustion to the surrounding medium. Hæmoglobin can be artificially separated from blood to form crystals, differing in shape according to the animal.

Usually, as in man, they take the form of prismatic needles or rhombic plates. It can furthermore be resolved into hæmatin, a dark brown amorphous powder, and an albuminous substance called globulin. Under the spectroscope it exhibits a very characteristic absorption spectrum,‡ by means of which Lankester and others have been able with absolute certainty to demonstrate its presence in the blood of certain invertebrates.

The hæmoglobin in the blood of vertebrates is contained exclusively in little circular disks,§ the red corpuscles. In the few instances in which it occurs in invertebrate animals, it is generally diffused in the plasma, e. g., in the blood of the earthworm and many other Chætopod worms, in some leeches (the Gnathobdellidæ), in some Nemertine worms (e. g. Polia), in the fresh water mollusk Planorbis, in a few small crustaceans (Cheirocephalus and the water flea Daphnia) and in the so-called bloodworm (the larva of the midge, Chironomus). Less frequently it is found concentrated in corpuscles, e. g. in the bivalve mollusks, Solen legumen and Arca noæ, in a few Chætopod worms (e. g. the Polychæta Glycera and Capitella), in some Gephyrean worms (Phoronis, Thalassema, Hemingia), in some Nemertine worms (e. g. Cerebratulus) and in a few Echinoderms (Thyonella, a sea cucumber, and Ophiactis, a brittle starfish).

These examples occur sporadically among such widely separated groups of animals that hæmoglobin must evidently have been independently acquired several times in the animal kingdom. It is clear that the possession of it does not in itself indicate any relationship.

Arterial blood is scarlet owing to the hæmoglobin containing a rich supply of oxygen; on the other hand, the dark purple color of venous blood is due to an excess of carbon dioxide. Both gases, however, are present in arterial as well as in venous blood; indeed, the former actually contains more carbon dioxide than oxygen. The difference in color, therefore, is merely a question of varying proportion, for an artificial solution of hæmoglobin changes color from purple to scarlet when a current of oxygen is passed into it. It is indeed probable that the oxygen enters into a state of unstable chemical combination with the hæmoglobin, and that the red corpuscle does not merely hold it as a sponge.

In this way the presence of hæmoglobin is an absolute necessity for the more remote internal parts of the body to receive a due supply of the vivifying oxygen and to get rid of the waste carbon dioxide. Indeed, it is doubtful whether vertebrates could have reached their great size and dominant position in the world without the possession of hæmoglobin in its valuable capacity for storing up oxygen. Hæmoglobin, however, is not confined to blood, but is contained in the voluntary muscles of the higher vertebrates (hence the red color of raw flesh) as well as in the tissue of the heart. Among fishes, however, it is entirely absent from the muscular tissue of the body, excepting in the fin muscles of the graceful little sea horse (Hippocampus). Among invertebrates it is found in the muscles of the pharynx of a few mollusks (Chiton, Pattella, Littorina, Paludina, Lymnæus and Aplysia), but strange to say, not in the blood of these creatures. In the Chætopod worm, the sea mouse (Aphrodite), it is even restricted to the nerve centers.

In reviewing the habits of those invertebrates which possess this valuable colored substance, we are able to infer that either (1) they show increased activity compared to their nearest relations, as in the case of the Neapolitan razor shell (Solen legumen); or (2) they live under circumstances in which oxygen is not easily obtained, as in the case of the bloodworm in the mud of stagnant pools, etc.; this is probably the main cause, and the power of being able to store up oxygen, whether in blood, muscle or nerve, must be a valuable aid in such adverse conditions; or (3) there may be a combination of these reasons, as in the leeches, which inhabit miasmic localities and yet show great activity, leaping upon any unfortunate man or animal invading their marshes. In the case of the bloodworm, Professor Miall has shown that it could live as long as five days in water that had been deprived of its oxygen by boiling.

The view that hæmoglobin has been primarily acquired merely as an expedient in conditions unfavorable to easy respiration is supported by the fact that the insect Chironomus possesses it only in its larval (bloodworm) stage, but when it reaches its final and winged state its blood is colorless. The disappearance of hæmoglobin in the blood of the perfect insect is indeed a highly remarkable fact; yet it is not surprising when we consider how thoroughly air is distributed to every tissue in an insect's body through the air tubes or tracheæ. The excessively delicate ramifications of these tracheæ extend into every muscle and even penetrate between the cells of the eye and of the nerve centers; hence, since every part of the body has direct access to the oxygen of the air, there is no need for this gas to be conveyed by the blood; consequently the circulatory system in insects is very imperfectly developed, and the blood is colorless.

Hæmoglobin does not, however, stand alone in the animal kingdom in its function of storing up oxygen. In the blood of certain tube-forming worms (Sabellidæ and Serpulinæ) a greenish substance, chlorocruorin occurs which has similar powers of absorbing oxygen and yielding it up to all parts of the body in need of it. It is, therefore, within the range of possibility that if the ancestor of the vertebrates had developed chlorocruorin in its blood in preference to hæmoglobin, our blood might be green, instead of red, and our admiration aroused by a verdant instead of a pink complexion.

* From Science Gossip.

† There appear to be only two exceptions to this rule, viz., the lancelet (Amphioxus), which is the lowest vertebrate, and the transparent little fish Leptocephalus, now regarded as the larval stage of the eel.

‡ It is interesting to note, as Prof. Church points out, that hæmoglobin possesses the same conspicuous absorption band in the ultra violet as chlorophyl, although, of course, the rest of the spectrum is very different.

§ Elliptical in fishes, amphibians, reptiles, birds and in the camel family. In the lampreys, however, the red corpuscles are circular.

MACHINE TO LOCATE FIRES.

Although the city of Vienna has an up-to-date fire alarm system, there is, however, constantly maintained a fire watch of several men on duty at all times in the tower of St. Stephen's Cathedral, the highest point in the city. For the purpose of locating a fire, there is in use a novel instrument known as the "toposcope," which is said to do its work in day or night with unerring accuracy, says the Boston Journal of Commerce. The toposcope consists of a good telescope, which is solidly attached to an arrangement of levers, while graduated sections of a circle are arranged horizontally and vertically in such a way that the moving of the telescope sideways or up and down results in a change of position of the hands attached to the levers in reference to the graduated scales. It is obvious, the stability of the apparatus being assured by their being firmly fastened, that whenever the telescope is focused upon the same object the hands will point to the same figures on the horizontal and on the vertical sexant, and, since an index of the whole city has been made, it is a matter of but a few seconds when a flare is discovered at night to direct upon the spot the toposcope on the respective side, to read off the numbers, to look up the object and to wire it to the central fire station, with all the details observed. Local conditions are, of course, necessary for the successful operation of this apparatus, but in this case they are almost perfect. St. Stephen's tower is over five hundred feet high; the great area of the city is situated in the broad valley of the Danube, allowing an uninterrupted panorama to the city limits. The atmospheric conditions are also favorable. The toposcope up there works so accurately that even at night the exact house and number were often given to the central by the watchman on the tower, while the next fire alarm box, being at a distance of three or four blocks, could not have given the exact location of the fire, and this would have delayed the arrival of the fire department accordingly.

The Sanitary Trustees of Chicago will build the largest swing bridge in the world across the drainage canal at Thirty-first Street and Campbell Avenue. Its total length will be 400 feet 5 inches, and its width will be 120 feet. The height of the center columns will be 68 feet; headway under the trusses for trains, 21 feet; headway under the bridge, 18 feet; and depth of water in the channel, 24 feet. The bridge will be of steel, weighing 7,000,000 pounds. It will be capable of supporting a train load of 8,000,000 pounds. The total cost is estimated at $700,000, including the machinery. Three railways will use the structure, crossing on eight tracks. The turn table will have a diameter of 80 feet, and the bridge will be swung in one minute, probably by electric power.

ENGINEERING NOTES.

The first home-manufactured locomotive in Japan was built in 1892-1893.—Prometheus.

The municipal council of Berlin has just decided, by a large majority, that henceforth the trolley system is to supplant the horse cars hitherto run on the Berlin tramways. The proposal of introducing cable cars has been rejected for the danger which such traction presents, both in technical matters and in hygiene.—L'Energie Electrique.

The spontaneous ignition of coal was known in antiquity. Theophrastus (320 B. C.) in De Lapidibus says: "At Bina (Thrace) there are found brittle stones which will burn, and have long been used as fuel, but they give an offensive smell. In some mines they find spinus, which will ignite spontaneously if crushed, heaped up and moistened." A writer of the eighteenth century attributes the spontaneous ignition of coal to the sulphur contained therein.—Prometheus.

Two tunnels are to be built under the Danube at Budapest. They are to connect the Parliament building with the Bomben Platz, and the Boraros Platz with the Kelenföld respectively. The two tunnels are to be built 15½ meters (about 50 feet) below the normal level of the river and are to be 10 meters (32½ feet) high. There will be a partition dividing each tunnel into an upper and a lower part. The upper part will be for pedestrians and tram cars, the lower part for ordinary traffic.—Uhland's Wochenschrift.

The system of Smith and Granville for connecting lighthouses with the coast is one of the most practicable. At the coast station two metal plates with cables attached are sunk into the earth. At the lighthouse two similar cables are connected to earth in the same way, but here some delicate instrument, such as a reflecting galvanometer, is included in the circuit. An alternating current is sent at intervals through the cables on the land station, and the secondary current produced in the lighthouse cables deflects the needle, so that messages can be sent according to a prearranged code.—Glaser's Annalen.

An ingenious way of simultaneously making and laying drain pipes is used by R. Dockery, at Los Angeles, Cal. The whole thing is done by a rather primitive machine. This consists of a tube, whose diameter corresponds to the outer diameter of the pipe to be produced, in which is fixed from inside a cylindrical plug, leaving a space for the clay to pass. The clay is supplied by a funnel and pressed out by the plug itself, which toward its internal extremity is threaded. During the operation the machine is sunk into the channel dug for the pipes and moves along in plow fashion.—Monatschrift für Oeffentlichen Baudienst.

The production of iron and steel wire nails in the United States in 1896 amounted to 4,719,860 kegs of 100 pounds each, compared with 5,841,403 kegs in 1895, a decrease of 1,121,543 kegs, or over 19 per cent. In 1894 the production amounted to 5,681,801 kegs and in 1893 to 5,095,945 kegs. The wire nails produced in 1896 were manufactured by seventy-three works, thirty-one more than were in operation in 1895. The production of 1896 represented 210,708 gross tons. The total production of cut nails in 1896 was 1,615,870 kegs of 100 pounds each, against 2,129,894 kegs in 1895, a decrease of 514,024 kegs, or over 24 per cent. There has been a steady decline in the production of cut nails since 1886, in which year the maximum production of 8,160,973 kegs was reached. In 1896 the production of wire nails exceeded the production of cut nails by over 3,103,000 kegs. The production of cut nails in 1896 represented 72,137 gross tons. Eleven States made cut nails in 1896.

A thirty-five foot entrance to New York harbor is strongly advocated by the Chamber of Commerce and the transatlantic and even coastwise steamship lines, says Engineering News. The river and harbor act of June 3, 1896, directed the Secretary of War to ascertain the location and cost of obtaining a depth of 35 ft. at low water mark from the "Narrows to the sea," and a report upon this head was submitted in January of 1897 by Colonel G. L. Gillespie, Corps of Engineers, U. S. A., and an abstract of this report was given at that time in this journal. A resurvey has now been ordered and the work is being carried on under Lieutenant-Colonel William Ludlow, Corps of Engineers, U. S. A., the successor of Colonel Gillespie. Lieutenant-Colonel Ludlow says that it is not proposed, as reported in the press, to deepen the Coney Island Channel to 35 ft., though that channel may be deepened to 16 ft. to better accommodate coastwise and excursion steamers. The actual work to be performed cannot be reported upon until the present surveys are completed, and all locations, plans and estimates of cost given in the press accounts are premature and unfounded.

The relative cost of transportation by railway and canal is thus expressed by Mr. Leslie R. Robinson in a paper on "Mechanical Propulsion on Canals," lately presented to the London Institution of Mechanical Engineers:

Items of Cost.	Railway.	Canal.
Maintenance of way	13	0
Maintenance of works	7	2·3
Repairs of rolling stock	19	6·0
Traction	16	8·0
Traffic expenses	30	6·0
General charges	15	15·0
Interest on capital	100	33·3
Totals	200	70·6

He says that the three principal causes why transport of heavy goods by canal costs only about one-third as much as by rail are the following: On a canal there is no cost corresponding to the wear and tear of rails, ties or track appliances, though the cost of maintaining banks and locks must be taken into account. In canals there is a corresponding saving of the repairs on engines and rolling stock resulting from running on a rigid permanent way. The most important cause for economy on canals, however, is the absence of vibration and the smaller magnitude of the works themselves. The table given is taken from the evidence of Mr. Couder before the parliamentary select committee on canals.

ELECTRICAL NOTES.

An enterprising burglar has at last ventured to use the means minutely described in some of our contemporaries for burning holes in a safe, says the Electrical World. A few days ago the bank of Messrs. Rogers & Son, at Chagrin Falls, Ohio, was found open and on the floor in front of the safe were found burglars' tools, a pile of sand, carbons and wires leading to the tracks and trolley wire of the street railway, near the building. It is said that big holes had been melted in the combination lock and the molten metal caught in the trough of sand on the floor below. The current had been shut off from the railway line during the night, and it is supposed that this compelled the burglars to desist.

Some Syracuse lads indulged in some "fun" with live electric wires recently. A wire which had been employed as a guy to support an electric light pole had come down and crossed a live wire in falling. The boys attached it to a piece of barbed wire from a neighbor's fence, and laid the latter across the cycle path, from which wheelmen would attempt to remove it in passing and receive a shock. Another trick was to throw it over a trolley wire, making a short circuit and stopping the cars. One boy, barefooted, playing about the spot, grasped the wire and ran his hand swiftly across a point where the insulation had worn off. He was standing with bare feet on the tracks of a disused trolley line at the time. The boy died in about eight minutes. He had received a shock from about 2,500 volts.

The Street Railway Review gives the following information as to the operating expenses of the Calumet Electric Railway, Chicago. The company operates 75 miles of track, all of it double except one mile. The number of cars in use varies from 37 in winter to 200 in summer. There are practically no grades on the line. The distance from the power house to the farthest terminal is 5½ miles. The coal used costs from $1.15 to $1.50 per ton. The road began operating in 1891, and has constantly extended its lines, having 10 miles in 1892, 23 miles in 1893, 53 miles in 1895, and 70 miles in 1896. John MacFayden, general superintendent of the Chester Traction Company, Chester, Pa., says that on that road the operating expenses for the year 1896 averaged $0·0759 per car mile. The company operates 28 miles of track, only two of which are double track; at the extreme end of one division, which is 8 miles from the power house, is a 6 per cent. grade, 1,500 feet long. There are several other grades of from 8 to 10 per cent. The average number of cars operated is 28 per day.

Electricity is finding uses in oil mining in Pennsylvania and promises to develop a large field of application in this direction. An oil company is erecting on one of its farms in Pennsylvania an electrical power plant to supply power for pumping all of its wells in that vicinity and also for drilling new wells. At present all this work is done by a small steam engine at each well, involving long steam lines, great waste of fuel and large expense for attendance. It is believed that a great saving will be effected by having a single power house with electrical transmission to a motor at each well. This plan has been adopted to a limited extent by other companies for pumping oil, but probably the only well hitherto drilled by electric power is the one put down by the Westinghouse Electric and Manufacturing Company near its factory at East Pittsburg, Pa. As the production of oil is a very large and important industry in this section of Pennsylvania, it is quite probable, according to the Electrician, that if the plan above referred to proves to be successful, it will pave the way for a very extensive use of electric power in the oil regions.

The Illustrated American has a description of a large electromagnet with pointed poles (both are pointed) designed for extracting iron filings or splinters that have lodged in the eye. Our contemporary gets quite graphic in describing the operation. "The instrument has a drawing force of 16 lb. As the eye of the patient is pressed toward its point the subtile magnetic power begins to draw upon the splinter. The metal, struggling for release, bulges the eye from the socket. If not too deeply embedded, the splinter will yield to the force, and, leaving the eye, become attached to the point of the magnet. But, as only too often occurs, the metal may strike with such force as to perforate the coating and drop down into the cavity of the eyeball. Especially is this the case when it passes through the iris or the pupil. One instance was mentioned by the attendants of the hospital of a splinter which passed entirely through the eye and lodged in the coating on the other side of the ball. Applied to the eye the big magnet will reveal with accuracy to the skilled sight of the physician the position of the troublesome particle. Knowing this, he can remove it by an operation. Only in the most desperate cases need loss of sight follow."

While an armature has been defined as a bundle of wires cutting magnetic lines, with suitable connections for carrying off the induced current, it is this "bundle of wires" which is the vital part of our electric systems to-day, and has given more trouble and study than all the rest of the system combined. The working capacity of armatures, according to Mr. G. Moffat, in the New York Electrical Engineer, may be said to be limited by two things, sparking at the brushes and the heating of the armature itself. Of these, the heating of the armature has been found the more troublesome of the two on account of the difficulty in overcoming it. To stop sparking at brushes, unless a structural defect, is much more easily accomplished. Besides the element of risk accompanying undue heating, there is a large waste of power, and power means money. In some machines tested, the author has found it necessary to reduce the load almost 50 per cent. before reasonable heating loss was met with. The maker's guarantee that the machine's capacity is 100 per cent. above what is found safe will not bring back the power thus wasted. The heating arising from the friction of brushes, if excessive, may be remedied by better brushes, springs no stronger than necessary to make perfect contact, a true commutator, and, if necessary, a little light-bodied oil applied occasionally which will quicken the polish. The main requisites for cool running would then seem to be: machines run at their true capacity, properly insulated, laminated cores and thorough ventilation.

MISCELLANEOUS NOTES.

According to the lately published statistics of 1895, the number of ships sailing into non-European ports (inclusive of the territories under German protection) has decreased by five; the tonnage, however, has risen by 84,430.—Uhland's Wochenschrift.

A novel system of allowing reduced fares has been instituted in Germany. According to new regulations, holders of ten third-class or eight second-class tickets, i. e., of a whole coupé, are entitled to a free return journey, ten days being the term allowed.—Uhland's Wochenschrift.

At the end of the year 1894 Japan had only twelve steamers of more than 3,000 tons and twenty-nine of more than 2,000. Now there are ten steamers of more than 5,000 tons, two of over 4,000, thirteen of 3,000 and over, fourteen of more than 2,000 and sixty over 1,000 tons. And building is constantly going on, so that there is a demand for increased harbor accommodation. Japan is threatening to become the greatest power on the Pacific.—Uhland's Wochenschrift.

Gas pipes have been made of paper in England. They are said to answer their purpose very well, particularly for underground conduits. They are made of any length required, and passed through liquid asphalt, to render them gas and water tight. It is said that these pipes resist the dampness of the ground, high pressure, and other inconveniences, better than the usual metal pipes. It is, however, doubtful whether good iron pipes coated inside and out with asphaltum are not superior to the cellulose article.—Prometheus.

A new material for paving streets is found in straw. A Polish engineer has designed a method and machinery by which straw is bound with wire, immersed in various hot liquids, and finally in pitch. The straw is then cut into cubes, much like those used for wooden pavement, and is ready for use. These blocks are said to be considerably cheaper than wood, and quite as durable. The straw used must be from unthrashed corn, otherwise it is broken and unfit for the process. The inventor has devised a machine which cuts off the ears from the straw.—Monatschrift für Oeffentlichen Baudienst.

Dr. Joseph Wittlin has made researches as to the value of the various modes of freeing roads from dust. He found that the action of the sun's rays was deadly to bacteria, but that the sprinkling of streets counteracted their effect. So the method of conveying the dust dry to the gutters by means of brushes and then carrying it to the drains by a stream of water is more commendable than the usual sprinkling. But better still is the course taken in England and some parts of America, where the dust is swept together and destroyed by combustion.—Monatschrift für Oeffentlichen Baudienst.

A simple process for bronzing steel, iron and copper is described in Revue de l'Electricité. The article to be bronzed is coated with vaseline, and then heated to redness, and left to itself till the desired color is attained. A second application of vaseline may be necessary if the first supply is burnt away before this point is reached. The article is then allowed to cool and cleaned of the carbonaceous matter clinging to it by rubbing with vaseline. The tint, which resembles that of gunmetal, is probably due to superficial oxidation. The bronze is very permanent, and particularly suitable for steel.

In connection with the recent state procession of the Queen to St. Paul's Cathdral some interesting particulars have been published by the Buildings Committee of the London County Council with respect to the erection of stands. It appears that in all 1226 applications for licenses to erect temporary stagings to view the procession were received. Of these 1,104 were granted, but in forty-eight cases the licenses were not taken up—ninety were refused, eight were withdrawn, and twenty-four were made too late for them to be dealt with. Two hundred and two structures in various parts of London, consisting chiefly of temporary stands and balconies, were condemned.

The Revue Scientifique draws our attention to the longevity of astronomers. We cannot reproduce their whole list of instances, but it may be interesting to our readers if we mention a few. First in the list comes Fontenelle, who lived just 100 years (1657-1757). Then Caroline Herschel, sister to the great Herschel, who reached her 98th year. Cassini died at 97, Sir Edward Sabine at 94, Moiran at 93, Giovanni Santini and Sharpe at 91. Yates, Airy, Von Humboldt, Robinson and Long each lived to the age of 90. The list of those who lived 80 years is so long that we can only give quite a small fraction of the names. Among them figure Halley, Newton, Herschel, Kant and Roger Bacon.

Writing in the scientific department of the Debats, M. Henri de Parville announces that two investigators, MM. Thomassi and Asselot, have succeeded in obtaining a non-inflammable celluloid. M. Thomassi's invention remains his secret, but M. Asselot has given his discovery to the world without delay. He dissolves ordinary celluloid in acetone in the proportion of 25 grammes of the former to 250 grammes of the latter. Then he dissolves, separately, 50 grammes of magnesium chloride in 150 of alcohol, and forms a paste of the two solutions. When the volatile solvents have evaporated there remains, according to M. Asselot, a celluloid which is absolutely uninflammable. He has, it may be trusted, made no mistake, for there can be no doubt that ordinary celluloid, which is mainly guncotton and camphor, is as dangerous as it is useful.

The importation of petroleum into Trieste in tank steamers has given rise to an Austrian governmental inquiry as to the vapor of petroleum hanging about the tanks and the dangers arising from the explosive mixtures to which it gives rise, says the American Manufacturer. The result is that a method has been adopted by which the air from various parts of the tank is extracted and subjected to a threefold test—with a eudiometer to see whether there is any diminution of volume on explosion, with a Davy lamp to see whether the flame is altered by the suspected air, and with an open flame to see if it is inflammable, and if so, what kind of flame is produced; and it is only when these three tests are satisfactory that a light can be allowed near the tank. Otherwise, ventilation must be vigorously carried out until there is no explosive mixture in any part of the tank.

SELECTED FORMULÆ.

Puncture Cement.—A recently patented preparation for the automatic repairing of punctures in bicycle tires consists of glycerine holding gelatinous silica or aluminum hydrate in suspension. Three volumes of glycerine are mixed with one volume of liquid water glass, and an acid is stirred in. The resulting jelly is diluted with three additional volumes of glycerine, and from four to six ounces of this fluid are placed in each tire. In case of puncture, the internal pressure of the air forces the fluid into the hole, which it closes. Further details are lacking.—American Druggist.

Hair Dye.—There is no hair dye which produces a durable coloration; the color becomes gradually weaker in the course of time, and the new growth of hair always requires after coloration. Here are some typical formulas in which a mordant is employed:

(1.) Nitrate of silver ½ ounce.
Distilled water 3 "

Mordant:
Sulphuret of potassium ½ "
Distilled water 3 "

(2.)
(a.) Nitrate of silver (crystal) 1½ "
Distilled water 12 "
Ammonia water, sufficient to make a clear solution.

Dissolve the nitrate of silver in the water and add the ammonia water until the precipitate is redissolved.

(b.) Pyrogallic acid 2 drachms.
Gallic acid 2 "
Cologne water 2 ounces.
Distilled water 4 "

(3.) Nitrate of silver 20 grains.
Sulphate of copper 2 "
Ammonia, q. s.

Dissolve the salts in ½ ounce of water and add ammonia until the precipitate which is formed is redissolved. Then make up to 1 ounce with water. Apply to the hair with a brush. This solution slowly gives a brown shade. For darker shades, apply a second solution, composed of—

Yellow sulphide ammonium 2 drachms.
Solution of ammonia 1 "
Distilled water 1 ounce.

Black Hair Dye Without Silver.—

Pyrogallic acid 3·5 grms.
Citric acid 0·3 "
Boro-glycerin 11 "
Water 100 c. c.

If the dye does not impart the desired intensity of color, the amount of pyrogallic acid may be increased. The wash is applied evenings, following in the morning by a weak ammoniacal wash.

One Bottle Preparation.—
Nitrate of copper 360 grains.
Nitrate of silver 7 ounces.
Distilled water 60 "
Water of ammonia, a sufficiency.

Dissolve the salts in the water and add the water of ammonia carefully until the precipitate is all redissolved. This solution, properly applied, is said to produce a very black color; a lighter shade is secured by diluting the solution. Copper sulphate may be used instead of the nitrate.—Pharmaceutical Era.

The firm of Golson & Joure have found a mixture suitable for match heads which, although containing no white or yellow phosphorus, may be ignited by friction against any substance. The proportions are:

Powdered glass 80 parts.
Amorphous phosphorus 10 "
Sulphur 10 "

These are mixed, then is added a solution of 850 parts of potassium chlorate in 300 parts of water and 70 of glue. Lastly, there is added to the paste finely powdered potassium ferrocyanide, 50 parts.—Wiener Gewerbe Zeitung.

Photographic Hints and Formulas.—

From Liesegang's Photographischer Almanach.—(Amer. Photo. Jl.)

Metol-Hydro Developer.—For transparency and lantern plates:

(a.) Water 16 ounces.
Metol 30 grains.
Hydrochinon 30 "
Sodium sulphite (crystals) 240 "

(b.) Water 10 ounces.
Potassium carbonate 120 grains.

(c.) Potassium bromide 1 ounce.
Water 10 "

To develop: (a) 1 oz.; (b.) 1 oz.; (c.) 10 to 20 drops.

Can be used repeatedly. Temperature should be between 70° and 75° F. Too cold a developer will not give density, while a warm developer tends to give fog.

A Blue Process.—M. Makahara, at the convention of the Japanese photographers, held in Tokio, exhibited some blue prints of rare beauty. The process by which they were obtained was given as follows: A strongly sized paper is necessary. Dissolve 15 grammes of gum arabic in 110 c. c. of hot water; while hot add—

Tartaric acid 2 grms.
Chloride of sodium 9 "
Sulphate of iron 10 "
Perchloride of iron 15 "

The mixture is applied with a sponge to the paper, the sponge then squeezed out, and the excess of liquid removed—in fact, as much as possible is removed. Printing is a little longer than for albumen paper; the yellow of the sensitive paper turns white in printing. The prints are developed rapidly with gallic acid, then washed and sponged.

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